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TECHNICAL MANUAL

FIELD MAINTENANCE AND REPLACEMENT

TURBOJET ENGINES

MODELS

J47-ST-25
J47-ST-25A
J47-GE-23
J47-GE-25
J47-GE-25A
J47-GE-27
J47-PM-25
J47-PM-25A

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SECTION I
INTRODUCTION

1–1. GENERAL.

1–2. This handbook contains field maintenance and replacement instructions for turbojet engine models J47–GE–23, J47–GE–25, J47–GE–25A, and J47–GE–27, designed and manufactured by the General Electric Company, Evendale, Ohio. Also included are instructions on models J47–ST–25 and J47–ST–25A, manufactured by the Studebaker Corporation, South Bend, Indiana, and models J47–PM–25 and J47–PM–25A, manufactured by the Packard Motor Company, Detroit, Michigan. (See figures 1–1 through 1–6.) The manufacturers' initials (GE, ST, or PM) will be omitted in these instructions. Instructions apply to all models unless specific reference is made to particular models.

1–3. Personnel using this handbook should be familiar with T.O. 2J–J47–22, Handbook of Service Instructions, and other publications on J47 engines. To select replacement parts, refer to T.O. 2J–J47–24, Illustrated Parts Breakdown.

1–4. Accomplishment of repair as prescribed herein has no effect on engine time. Submit deficient reports on engine parts and accessories in accordance with applicable directives. Upon completion of field maintenance, fill out the required forms indicating the date of repair, the parts replaced, the reason for replacement and the activity performing the work.

1–5. Replace engine parts which would serve for a short period of time but which, in the opinion of the inspector, might fail before the next overhaul of the engine. A minimum of repair and maintenance work should be performed between overhaul periods, but flight safety should never be sacrificed.

1–6. Disassemble the engine only as far as is necessary to replace defective parts or to perform necessary inspections or repairs even though instructions for more extensive disassembly may be given herein.

Note

Even though repair of existing damage is within field maintenance capabilities, consideration should be given to hours accumulated since overhaul, general condition of and service life remaining in the engine, past malfunctions, performance and maintenance difficulties experienced, and extent of repair or maintenance required to return the engine to a safe, serviceable condition.

1–7. After assembly, the engine must be subjected to a functional or performance test as specified in Section VII before preparing it for storage or installing it in an aircraft.

1–8. Frequent reference is made to the Table of Limits, Section VIII. Use the listed tolerances, clearances, and limits for all operations involving measurement or use

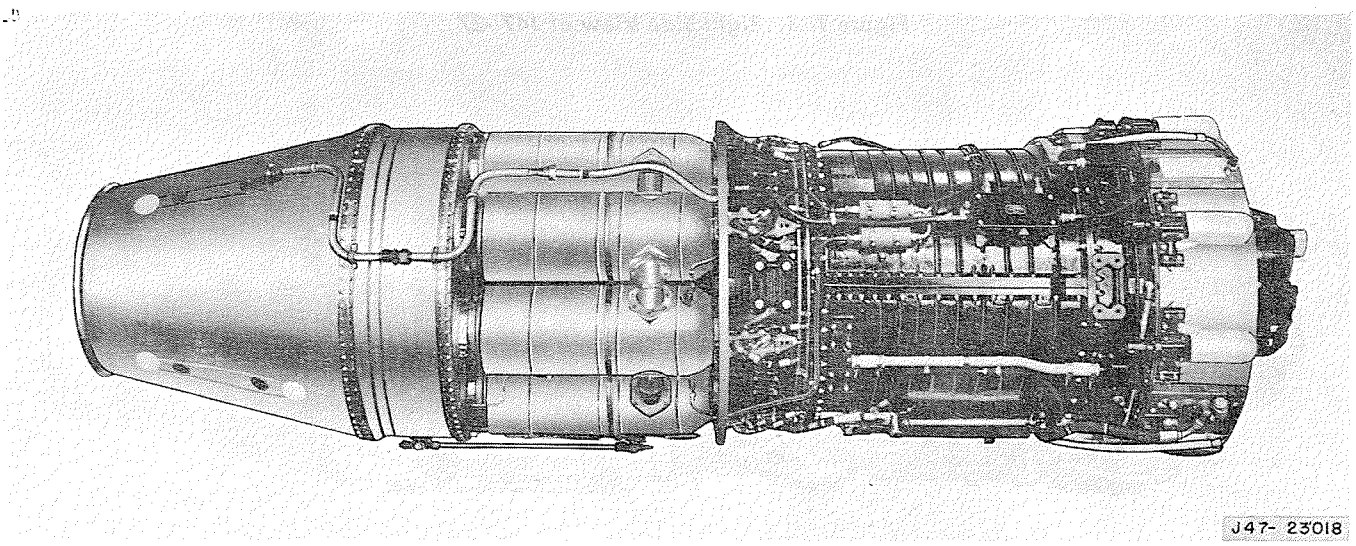


Figure 1–1. Right Side View of J47–23

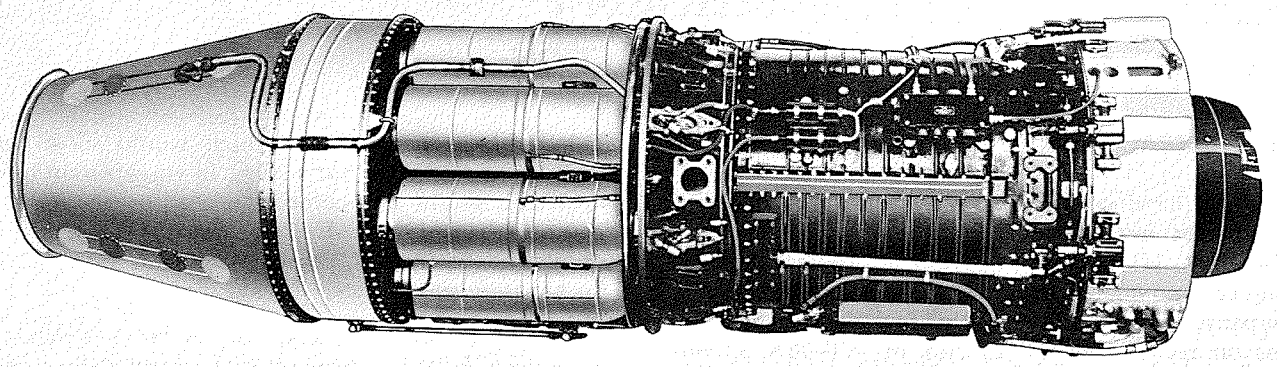


Figure 1–2. Right Side View of J47–25, –25A

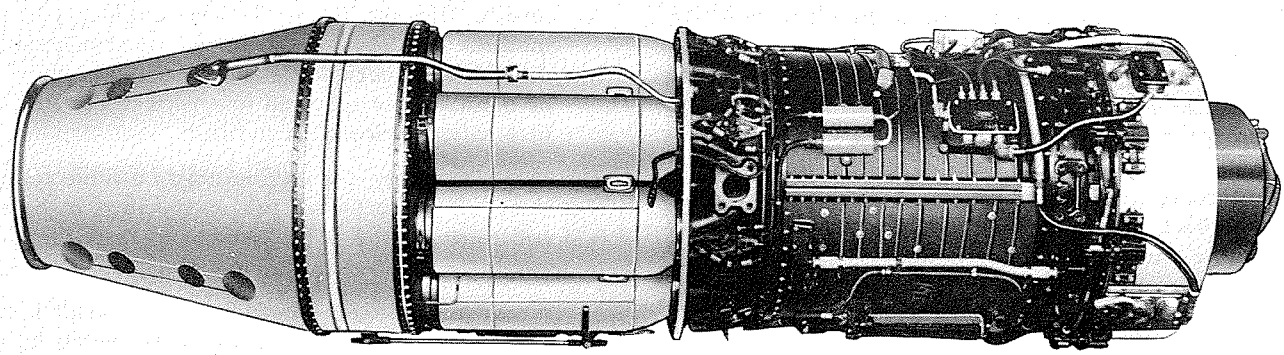


Figure 1–3. Right Side View of J47–27

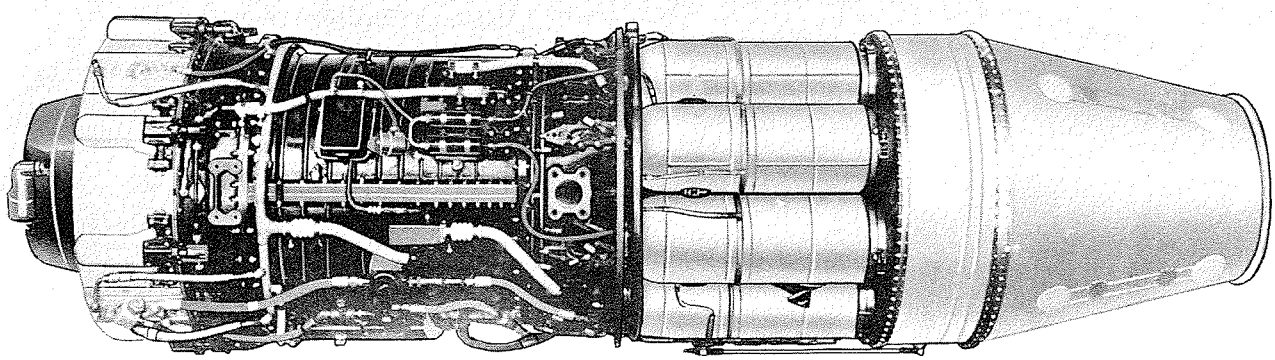


Figure 1–4. Left Side View of J47–23

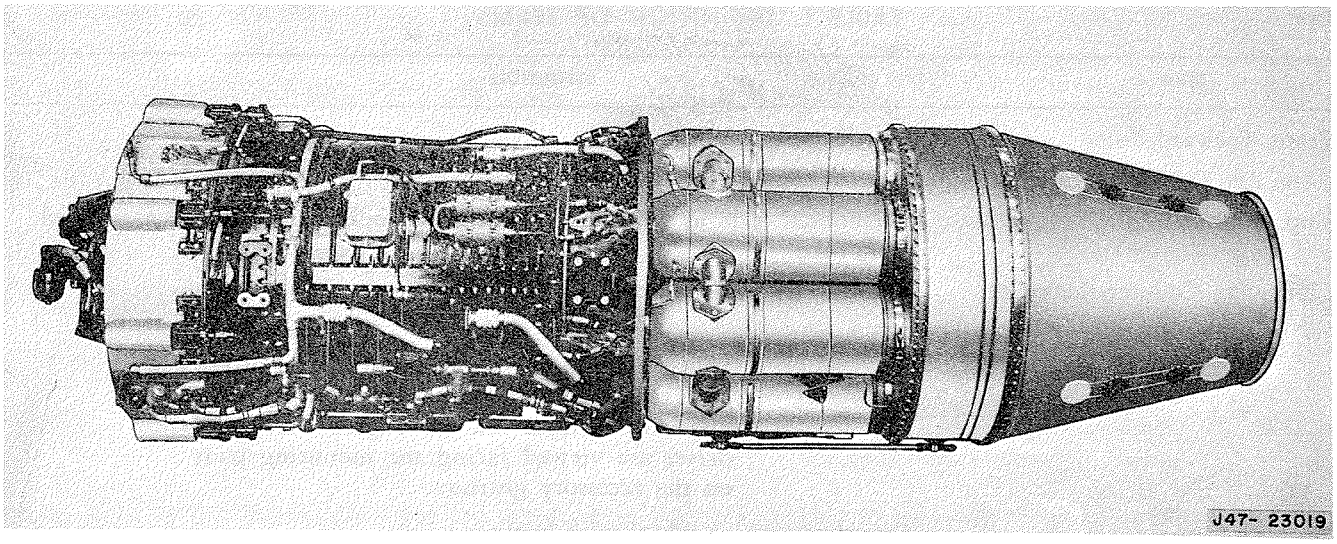


Figure 1-5. Left Side View of J47-25, -25A

of gages. Limits given in Section VIII must be carefully maintained during field maintenance operations.

1-9. The terms explained in Table I will be used throughout this handbook. The terminology indicated in figure 1-7 will be used regardless of the position of the engine at the time.

1-9A. Significant changes added in this change are listed in Table I-A.

1-10. DESCRIPTION OF ENGINE.

1-11. GENERAL. The engine consists basically of an axial-flow compressor with 12 stages, a set of through-flow combustion chambers, a single stage turbine, and a fixed opening exhaust nozzle. The compressor rotor shaft and the turbine shaft are joined with a spline-fit and locked with a turbine shaft tie-bolt. The main shafts and rotors are supported by 4 anti-friction bearings. The No. 1, or front, bearing is located at the front end of the compressor rotor; the No. 2, or mid-bearing, is located at the rear of the compressor rotor; the No. 3, or damper, bearing is located at the middle of the turbine shaft; and the No. 4, or rear, bearing is located at the rear of the turbine shaft just forward of the turbine wheel. The No. 2 bearing is a ball (thrust) bearing; the others are roller bearings. The 5 major sections of the engine are illustrated in figure 1-8.

NOTE

The sections illustrated in figure 1-8 are not procurable as units; they do not necessarily correspond with the main assemblies listed in the Illustrated Parts Breakdown.

1-12. ACCESSORY SUPPORT MOUNT AND FRONT COWL SECTION (1, FIGURE 1-8). At the time of engine shipment, the alternator drive is not installed on the J47-23, -25 and -25A engines. For

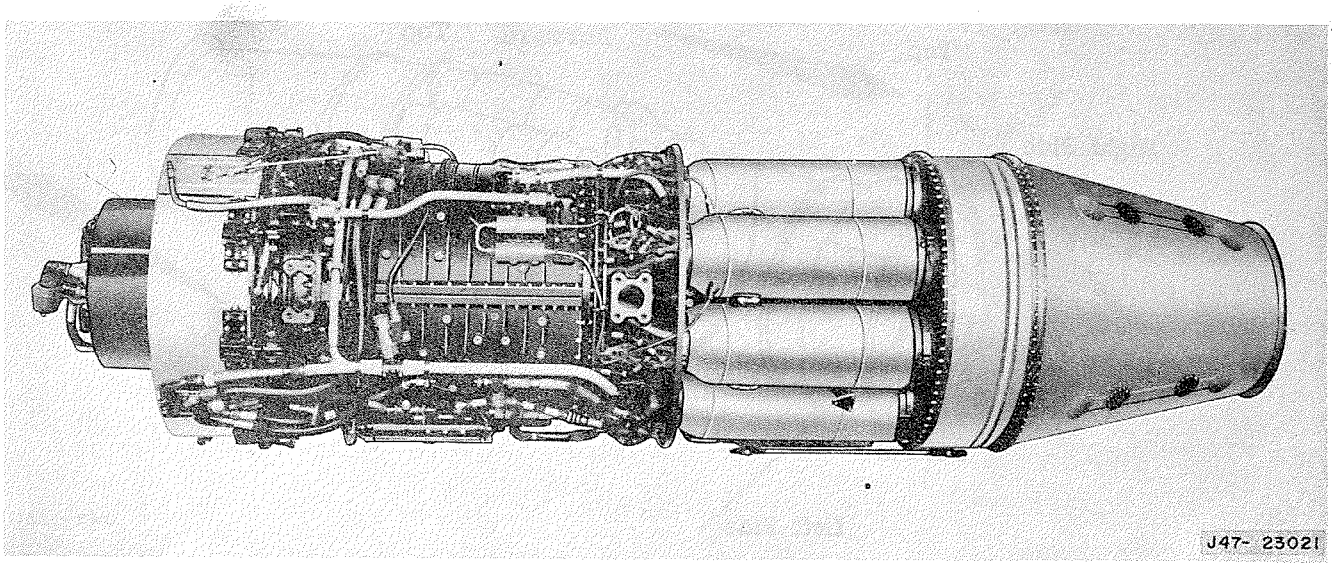


Figure 1-6. Left Side View of J47-27

TABLE I. DEFINITION OF TERMS

TERM	DEFINITION
Front, Forward, Inlet	Upstream, or air inlet end.
Rear, Aft, Outlet	Downstream, or exhaust outlet end.
Top, Bottom, Right, Left	Directional term as with engine in normal operating position as viewed from rear.
Clockwise, Counter-clockwise	Rotation right to left, or left to right. **Note** When describing direction of rotation of engine rotor and any other shafts parallel to it, view shafts from rear of engine. Accessory drives are viewed facing the mounting pads on the accessory gearbox.
Turbine Rotor	Complete turbine wheel with buckets.
Compressor Rotor (or Rotor)	Complete assembly of rotor wheels with blades.
Wheel	Turbine wheel or compressor rotor wheel without buckets.
Compressor Stage	A compressor wheel and the following vane assembly.
Ignition	Electric arc which ignites the fuel/air mixture.
Ignition Plug	Electrical device used for igniting the combustible mixture for engine starting.
Thrust	The propelling force expressed in pounds. Thrust is the unbalanced forward force generated within the engine.

installation of the engines in the B–47 aircraft, power take-off kits are provided for both inboard and outboard locations. The inboard kits have a 10 inch alternator mount casting (without bearing or drive assembly) for supporting accessories and mounting the bullet nose. The outboard kits have an alternator mount with bearing and shaft assembly. The alternator is driven through a shaft splined to the compressor rotor.

1–13. On the J47–27 engines the power take-off consists of a hydraulic pump drive housing, gears and bearings, a splined drive shaft, supporting legs, and a cowling. Fluid power pumps are mounted on two pads on the front face of the housing.

1–14. All engines have a cowling support between the auxiliary drive gear case and the compressor front frame. This support encloses the engine-driven accessories and forms the inner shell of the inlet air guide.

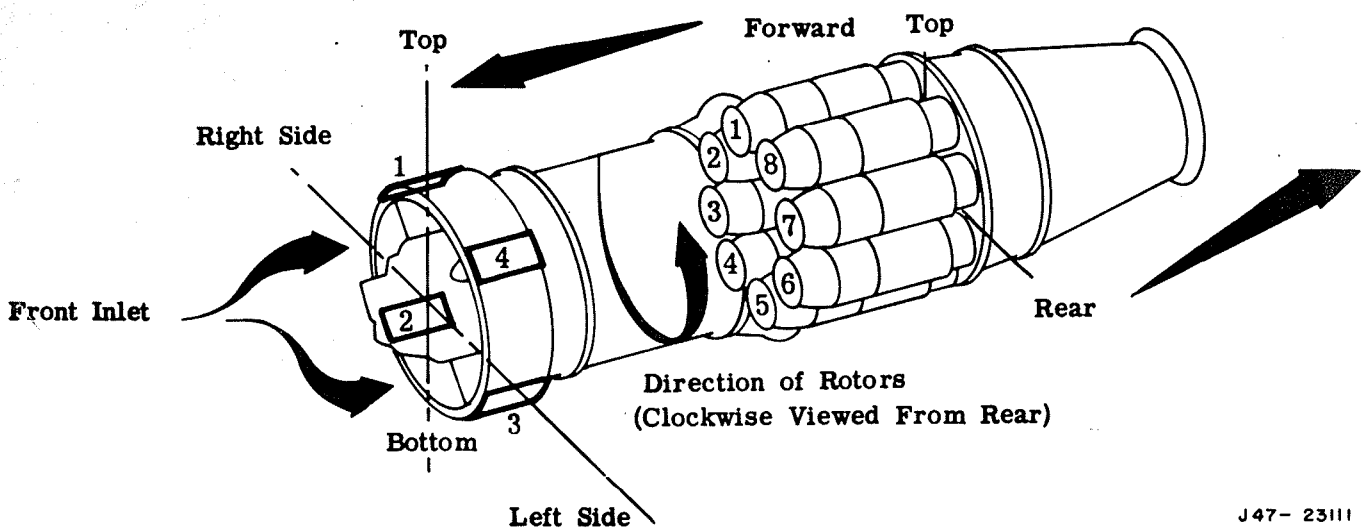
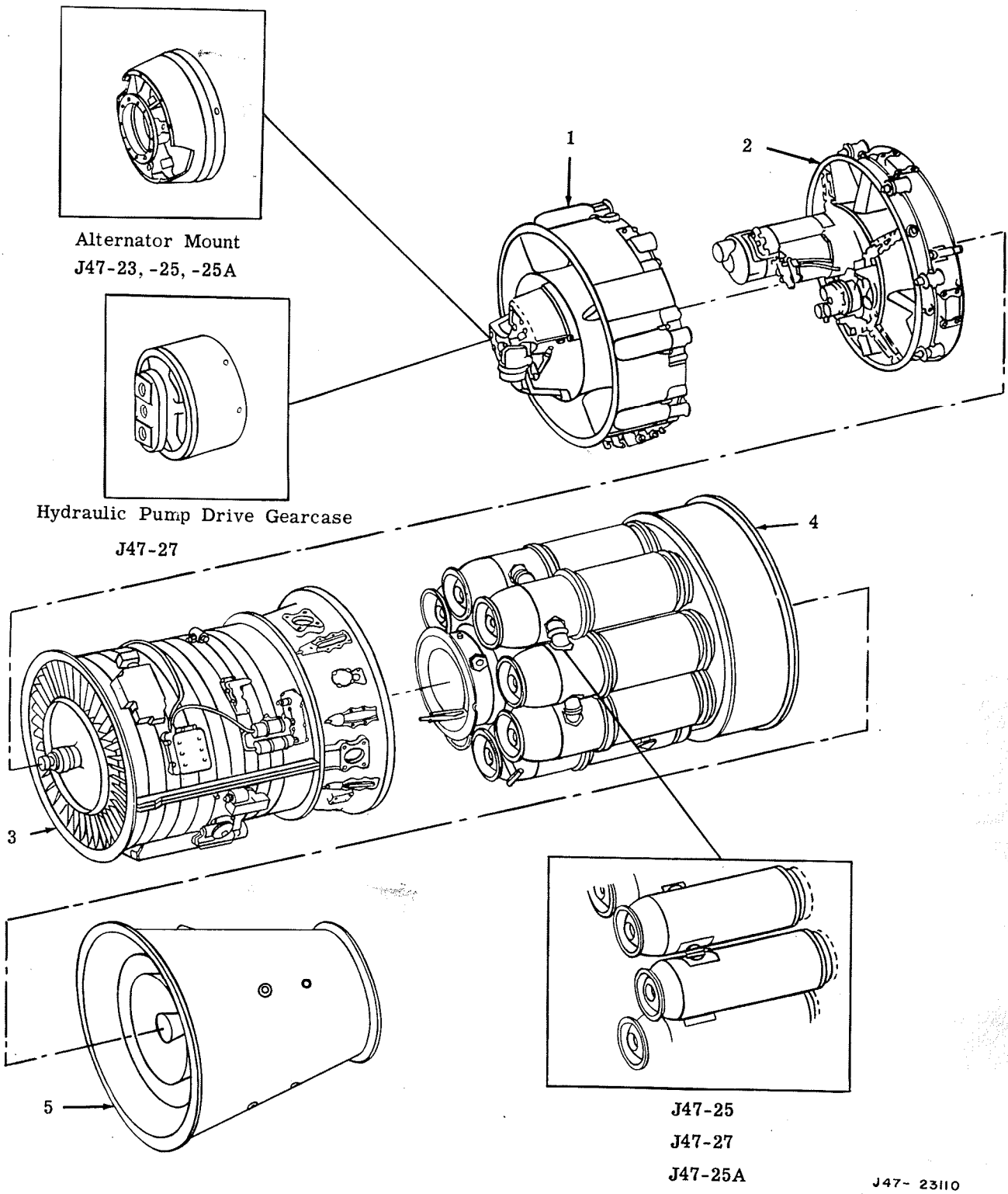


Figure 1–7. Terminology

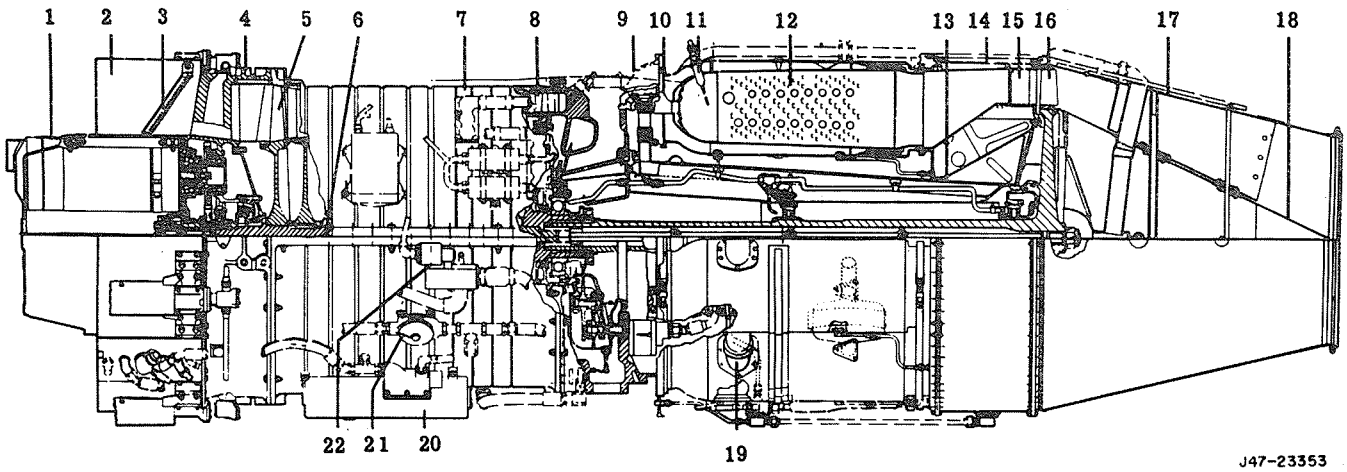
TABLE I-A. SIGNIFICANT CHANGES

Section	Item		Para (P) Fig (F) Table (T)
IV	General Material Specifications	PCR 74-4-78	(T) IX
V	Remove References to Graphite Lubricants		(P) 5-18 (P) 5-34
VI	Control Linkage and Emergency Control Linkage Installation		(P) 6-30



1. Accessory Support Mount and Front Cowl Section
2. Air Guide Section and Compressor Front Frame
3. Compressor Section
4. Combustion and Turbine Section
5. Exhaust Section

Figure 1-8. Major Sections of J47-23, -25, -25A, -27



1. Engine Driven Accessories
2. Air Guide Section
3. Inlet Air Screen
4. Compressor Front Frame
5. Compressor Rotor Blades
6. Compressor Rotor
7. Compressor Stator Casing
8. Compressor Stator Blades
9. Compressor Rear Frame
10. Fuel Nozzle
11. Igniter Plug
12. Combustion Chamber
13. Turbine Frame
14. Turbine Casing
15. Turbine Nozzle
16. Turbine Rotor
17. Exhaust Cone
18. Inner Cone
19. Cross-Ignition Tube
20. Ail Cooler and Thermal Bypass Valve
21. Oil Filter
22. Anti-Icing Valves

Figure 1–9. Cutaway View of J47–23, –25, –25A, –27

1–15. AIR GUIDE SECTION. The air guide section (2, figure 1–9) consists of island covers, island fairings, air guide sectors, and a set of retractable inlet screens (1). This section directs the air into the compressor inlet. The fairing-covered islands are utilized as passageways for lube oil, fuel, anti-icing air, hydraulic fluid, electrical lines, and a throttle linkage. The island covers are used as junction points for these lines. The island sectors, installed between the island covers, form the outer shell of the inlet air guide.

1–16. COMPRESSOR FRONT FRAME. The compressor front frame (4, figure 1–9) assembly includes accessory drive gears and mounting pads, support and seals for the No. 1 bearing, and the inlet guide vane. The front frame consists of inner and outer sections connected by eight struts. Support for the drive gears, shaft housing, No. 1 bearing housing, and allied parts is provided by the inner section. There are 4 engine mounting pads, 2 on the horizontal and 2 on the vertical centerlines, on the compressor front frame.

1–17. INLET GUIDE VANES. The inlet guide vanes are hollow blades or vanes mounted between two concentric rings. The vane assembly is attached to the rear side of the inner section of the compressor front frame together with an air seal for the shelf of the first stage wheel of the compressor rotor. The area between the rear face of the front frame assembly and the forward face of the first stage wheel of the compressor forms the balance-piston air chamber. This chamber is supplied by air from the twelfth stage of the compressor through the inlet guide vanes and counteracts some of the forward thrust of the rotor.

1–18. COMPRESSOR ROTOR. The engines have two types of compressor rotors (6, figure 1–9). The early engines had a shaft type rotor with 12 compressor wheels shrunk to a steel shaft. The wheels in the first 9 stages are made of aluminum; the tenth, eleventh, and twelfth stage wheels are made of steel to withstand the high temperatures and pressure at the rear of the compressor.

1–19. The curvic coupling compressor rotor consists of 12 wheels with a ring of gear teeth machined on both faces of the second through the eleventh stage compressor wheels. The rear face of the first stage wheel and the forward face of the twelfth stage wheel also have a curvic coupling. An extension shaft on the front face of the first stage wheel provides a journal for the No. 1 bearing and is externally splined to drive accessory gears and accessory drive shaft by means of couplings. The rear face of the twelfth stage wheel is extended to form a journal for the No. 2 bearing and is internally splined to receive the turbine rotor shaft. On the curvic coupling compressor rotor the first, ninth, tenth, eleventh, and twelfth stage wheels are steel and all others are aluminum alloy. The 12 wheels are held together with 12 tie-bolts.

1–20. Both types of rotors have 11 cylindrical spacer rings, one between each wheel. The rim of the wheel is secured to the spacer ring by steel pins. The compressor blades (5, figure 1–9) are dovetailed into the

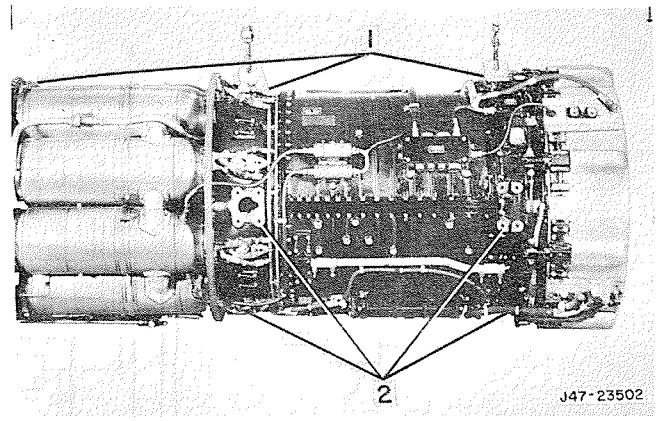
outer rim of each wheel, and the spacer rings prevent axial movement of the compressor blades.

1-21. COMPRESSOR STATOR. The compressor stator (7, figure 1-9) is an aluminum casing split at the horizontal centerline. Dovetailed into the inside of the aluminum casings are 13 blade rings. The compressor casings are supported at the front end by the compressor front frame and at the rear by the compressor rear frame by means of bolted flanges.

1-22. COMPRESSOR REAR FRAME. The center of compressor rear frame supports the No. 2 bearing and the rear face supports the combustion chambers, (12, figure 1-9). Equally spaced around the shell of the compressor rear frame are 8 diffuser passages which diffuse and direct the air from the compressor twelfth stage to the combustion chambers. Eight duplex fuel nozzles (10) are mounted on pads and extend directly into the diffuser passages with their tips projecting into the inner combustion chambers. The compressor rear frame (9) contains 4 engine mounting pads: 2 on the horizontal, and 2 on the vertical, centerlines.

1-23. COMBUSTION SECTION. Eight direct-flow type combustion chambers (12, figure 1-9) are mounted around the turbine frame. Each chamber consists of a double-walled cylindrical assembly attached to the compressor rear frame and turbine frame by means of quick-disconnect clamps. Compressed air from the diffuser passages enters the combustion chambers, passes into the annular spaces between the outer casings and the inner chambers. The air is mixed with fuel sprayed from the nozzles, and the fuel-air mixture is burned. The combustion chambers are interconnected by cross-ignition tubes (19) which make light-off in all chambers possible, even though igniter plugs (11) are installed in only 2 chambers. Eight transition liners are mounted around the aft section of the turbine frame. The function of the transition liners is to change the pattern of the exhaust gases flowing to the nozzle diaphragm. The hot gases leave the combustion chambers in 8 separate circular patterns and change to an annular pattern in the transition liners.

1-24. TURBINE SECTION. The turbine in the J47 engine is a single-stage gas turbine of the impulse type. It consists of a turbine nozzle (15, figure 1-9) and a turbine rotor (16) supported by the turbine frame (13) and enclosed by the turbine casing (14), which has a shroud ring to enclose the gases as they pass through the turbine buckets. The turbine frame is bolted to the rear of the compressor rear frame. The No. 3 and No. 4 bearings are supported by the housing of the turbine frame. The hollow turbine shaft is splined at the front end to mesh with the splines of the compressor shaft. Turbine buckets are dovetailed into the wheel rim. The front and rear surfaces of the turbine rotor are cooled by air bled from the compressor. The hot gases are directed by the stationary turbine nozzle against the turbine wheel buckets. The torque transmitted to the turbine rotor drives the compressor rotor and accessories.



1. Upper Mounting Points
2. Side and Bottom Mounting Points

Figure 1-10. Mounting Pads

1-25. EXHAUST SECTION (5, FIGURE 1-8). This section consists of an exhaust cone (17, figure 1-9) and a fixed-area exhaust nozzle. The exhaust section is bolted to the turbine casing and extends aft of the turbine wheel. After passing the turbine rotor buckets, the exhaust gases pass through the annulus formed by the outer and inner cones, and are discharged to the atmosphere through the nozzle at the rear of the exhaust pipe. Four thermocouples, wired in parallel and connected to the cockpit indicator, are installed 90 degrees apart at the rear of the exhaust section to indicate exhaust gas temperature.

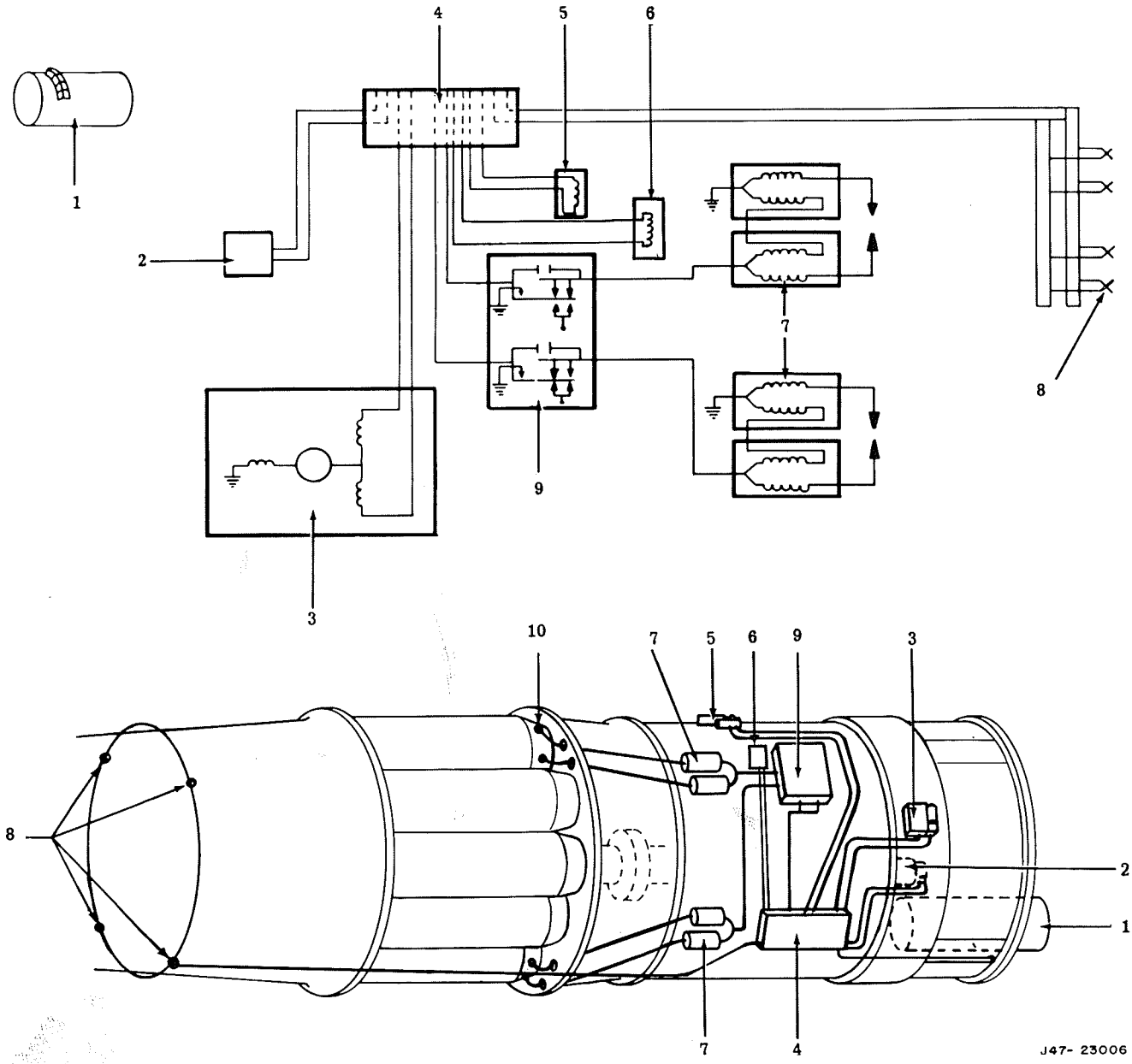
1-26. MOUNTING POINTS. (See figure 1-10.) Several mounting pads on the engine may be used for installing it in a nacelle or in a fuselage. The compressor front and rear frames each have four pads located 90 degrees apart around their circumference. On the J47-23, -25 and -25A engines, a bracket pad at the top centerline of the engine on the turbine frame burner plate is also used as a support point.

1-27. AUXILIARY COMPONENTS. Auxiliary components mounted on pads on the forward face of the front frame are the starter-generator, the fuel regulator, the fuel pump, and the main lube and scavenge pump. The tachometer generator is mounted on the main lube and scavenge pump. The rear scavenge pump is mounted inside the compressor rear frame and is driven by the main rotor through reduction gears.

1-28. MODEL DIFFERENCES. The major differences between models of the J47 engine are summarized in table II. A "X" appars in the model number column on the right of table II if the components listed on the left are installed on the model.

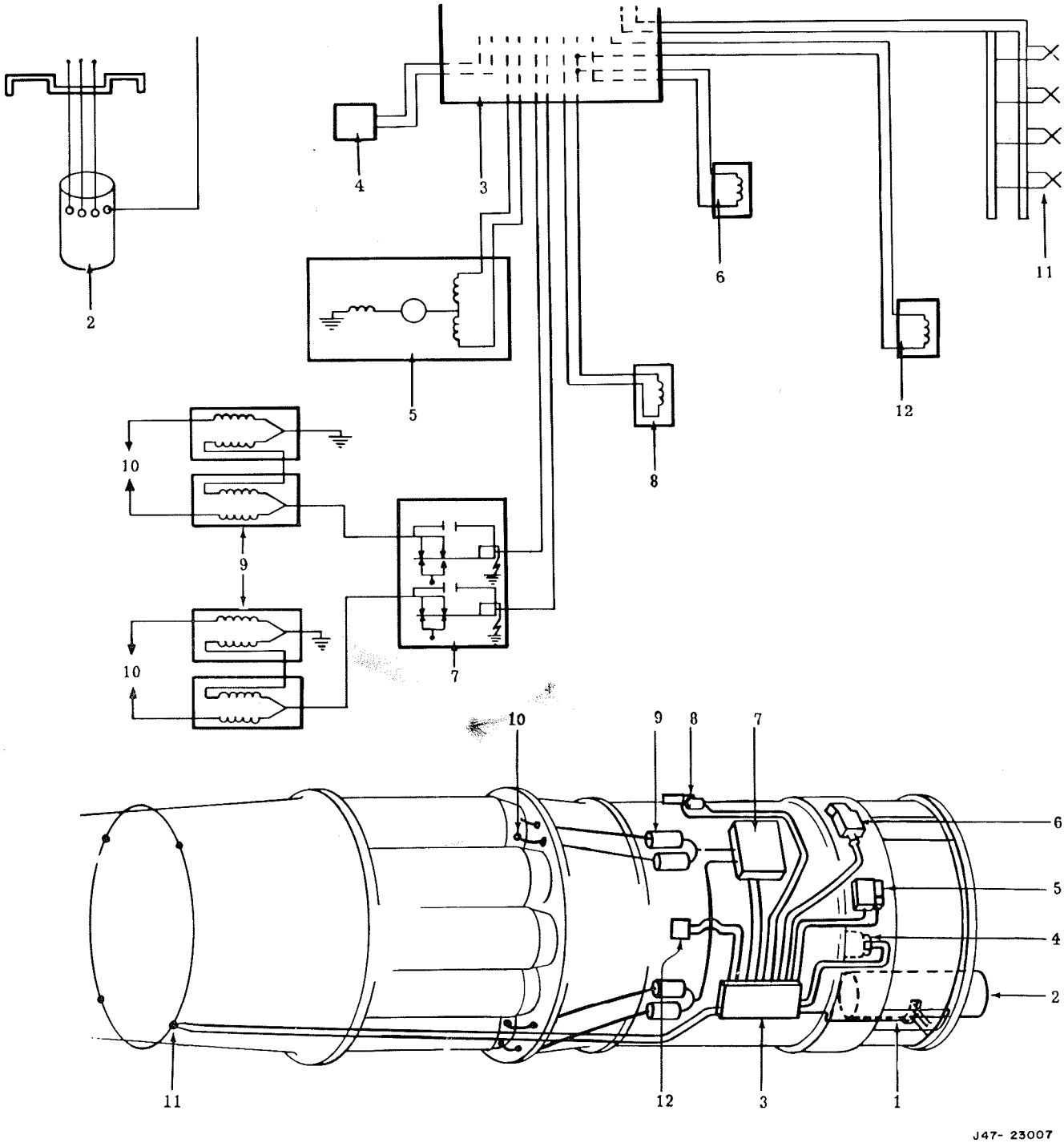
1-29. ENGINE SYSTEMS.

1-30. ELECTRICAL SYSTEM. The primary function of the electrical system (figures 1-11 and 1-12) is to provide energy for starting and ignition and to supply power for operation of engine and aircraft electrical



1. Starter-Generator
2. Tachometer Generator
3. Inlet Screen Actuator
4. Junction Box
5. Anti-Icing Valve
6. Compressor Discharge Solenoid Valve
7. Igniter Plug Coils
8. Exhaust Thermocouples
9. Ignition Vibrator
10. Igniter Plugs

Figure 1–11. Electrical System Schematic, J47–23, –25, –25A



1. No. 1 Island Cover
2. Starter-Generator
3. Main Junction Box
4. Tachometer Generator
5. Inlet Screen Actuator
6. Emergency Regulator Solenoid
7. Ignition Vibrator
8. Anti-Icing Valve
9. Igniter Plug Coils
10. Igniter Plugs
11. Exhaust Thermocouples
12. Compressor Discharge Solenoid Valve

Figure 1–12. Electrical System Schematic, J47–27

TABLE II. MODEL DIFFERENCES

Components	J47 –23	J47 –25	J47 –25A	J47 –27
Emergency fuel system				X
Compressor discharge pressure Bleed system (stall protection)	X	X	X	
Transition liner				
Annular type			X	
Standard post-type	X	X		X
Water-alcohol system				
Factory-installed on engine		X	X	
Provisions made for installing system on engine	X			
Combustion chambers				
Elliptical type		X	X	X
Bellows type	X			
Accessory support mount	Early Engines			
Power take-off unit				
Alternator drive	X	X	X	
Hydraulic pump drive				X
Cowl guides	X	X	X	
Trimmer valve (between small and large slot manifolds)	X	X	X	
Accumulator (fuel inlet line)	X	X	X	

equipment. The starter-generator is an engine-mounted accessory, but the wiring and electrical apparatus in the starting and generator circuit are part of the aircraft electrical system. The ignition system has a high-voltage and provides the spark necessary for starting the engine. This is a dc opposite-polarity ignition unit and consists of: one dual vibrator in a single package, 4 separate ignition coils, 4 igniter plugs, and interconnecting leads. The coils are connected in pairs: one pair serves the 2 igniter plugs in the No. 3 combustion chamber; the other pair serves the 2 plugs in the No. 7 combustion chamber.

1–31. LUBRICATION SYSTEM. (See figures 1–13 and 1–14.) The positive-displacement re-circulating lubrication system supplies metered oil to cool and lubricate all bearings, gears, and the auxiliary gear case. This system also supplies oil to the main fuel regulator for hydraulic control of the main fuel system. The lubrication system consists of a pressure and scavenge pump, an oil filter, an oil cooler, and check and relief valves. In addition, a single-element, hydraulic drive scavenge pump is incorporated into the J47–27 engine.

1–32. OPERATION OF LUBRICATION SYSTEM. Oil from an airframe-mounted tank enters the engine through the No. 2 island and passes to the inlet of the main pump, located on the lower left side of the accessory gear case cover as shown in figures 1–13 and 1–14. The main lube pump is a 3-element, positive-displacement, gerotor type pump with 2 pressure elements and one scavenge element.

1–33. Oil travels from the No. 1 pressure element through the No. 3 island, through the oil filter and check valve, the pressure transmitter and compressor rear frame, to the three jets located at the No. 2, No. 3, and No. 4 bearings. There is a pressure relief valve at the discharge side of the No. 1 element to relieve high oil pressures into the compressor front frame sump in the event of a restriction in the line. Two labyrinth air and oil seals at the No. 2 and No. 4 bearings prevent oil from leaking past the bearings during engine operation. A breather mounted on the turbine frame maintains a slight vacuum within the turbine frame to control air flow across the seals and prevent leakage past the seals.

1–34. The No. 2 supply element of the main lube pump transfers oil at high pressure past the anti-leak valve, the relief valve and screen, and into the main gear case. Four jets lubricate the gears within the gear case and a fifth jet lubricates the No. 1 bearing. Oil is routed from the No. 2 element system through a check valve, filter, and an orifice which reduces pressure and flow before it enters the main fuel regulator. This oil supply cools the regulator and maintains a proper oil level within it. The main fuel regulator schedules variable control oil to the fuel control valve. Oil from the main fuel regulator is returned to the system through the compressor front frame sump, which also collects scavenge oil from the accessory drive gears, No. 1 bearing, and the auxiliary drive (when used). The pressure relief valve bleeds lube oil into the front frame sump in the event of high pressure caused by a restriction. The scavenge element of the main lube pump routes oil from the sump through the fitting in the No. 3 island to the tank.

1–35. Oil from the rear bearings is scavenged by a double-element scavenge pump in the compressor rear frame. There are two sumps for scavenging the rear bearings: one in the compressor rear frame for the No. 2 bearing, and one under the No. 4 bearing. Oil from the No. 3 bearing collects at either of the sumps, depending upon the position of the engine. An internal passage carries oil from the No. 4 bearing sump to the rear element of the scavenge pump. Scavenge oil from the No. 2 bearing is routed to the forward element of the scavenge pump through a port in the forward flange of the pump.

1–36. Scavenge oil from the rear scavenge pump flows through a check valve to the oil cooler. While passing through the oil cooler the oil is cooled by a process of heat exchange whereby the hot oil transfers a large

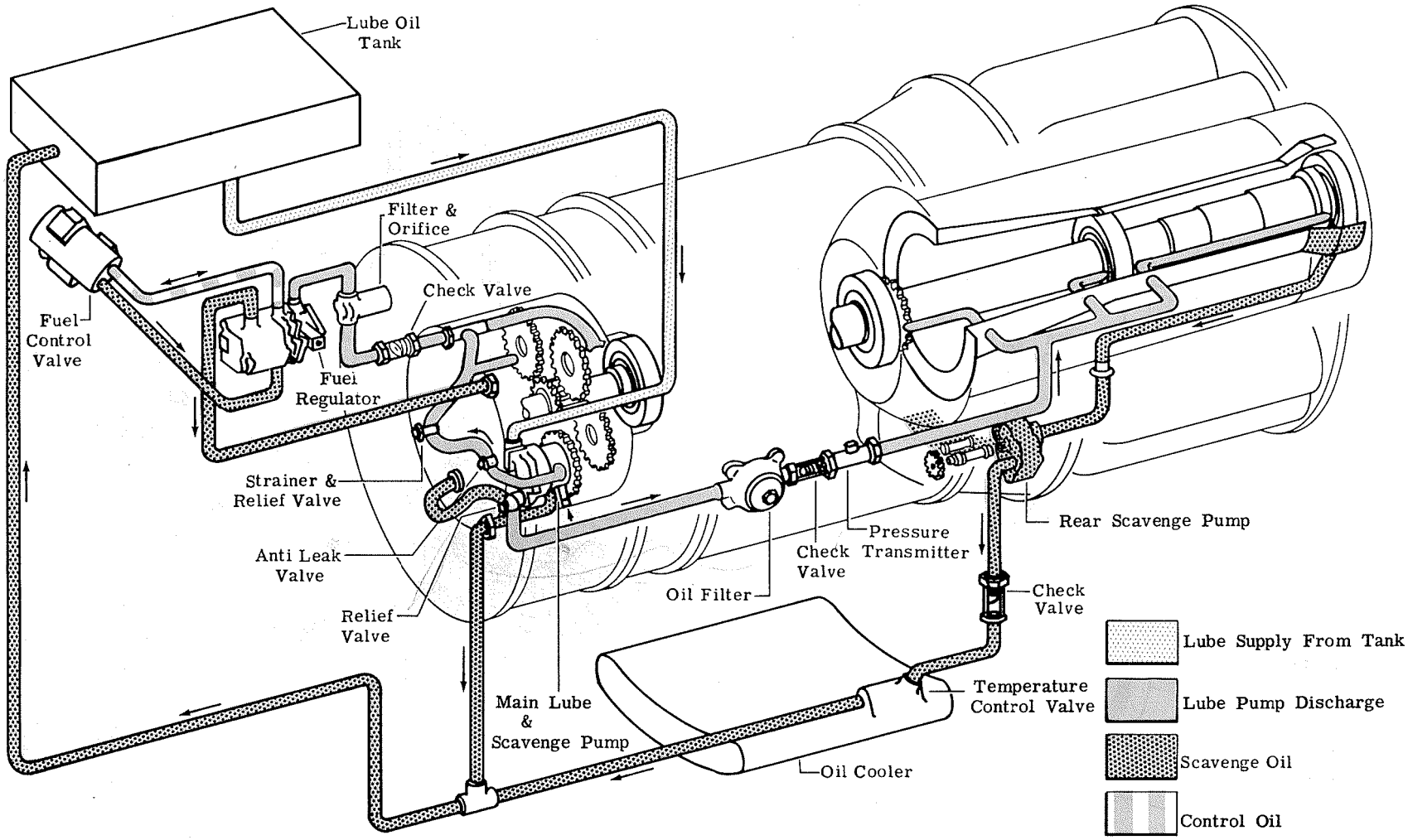


Figure 1–13. Lube Schematic, J47–23, –25, –25A

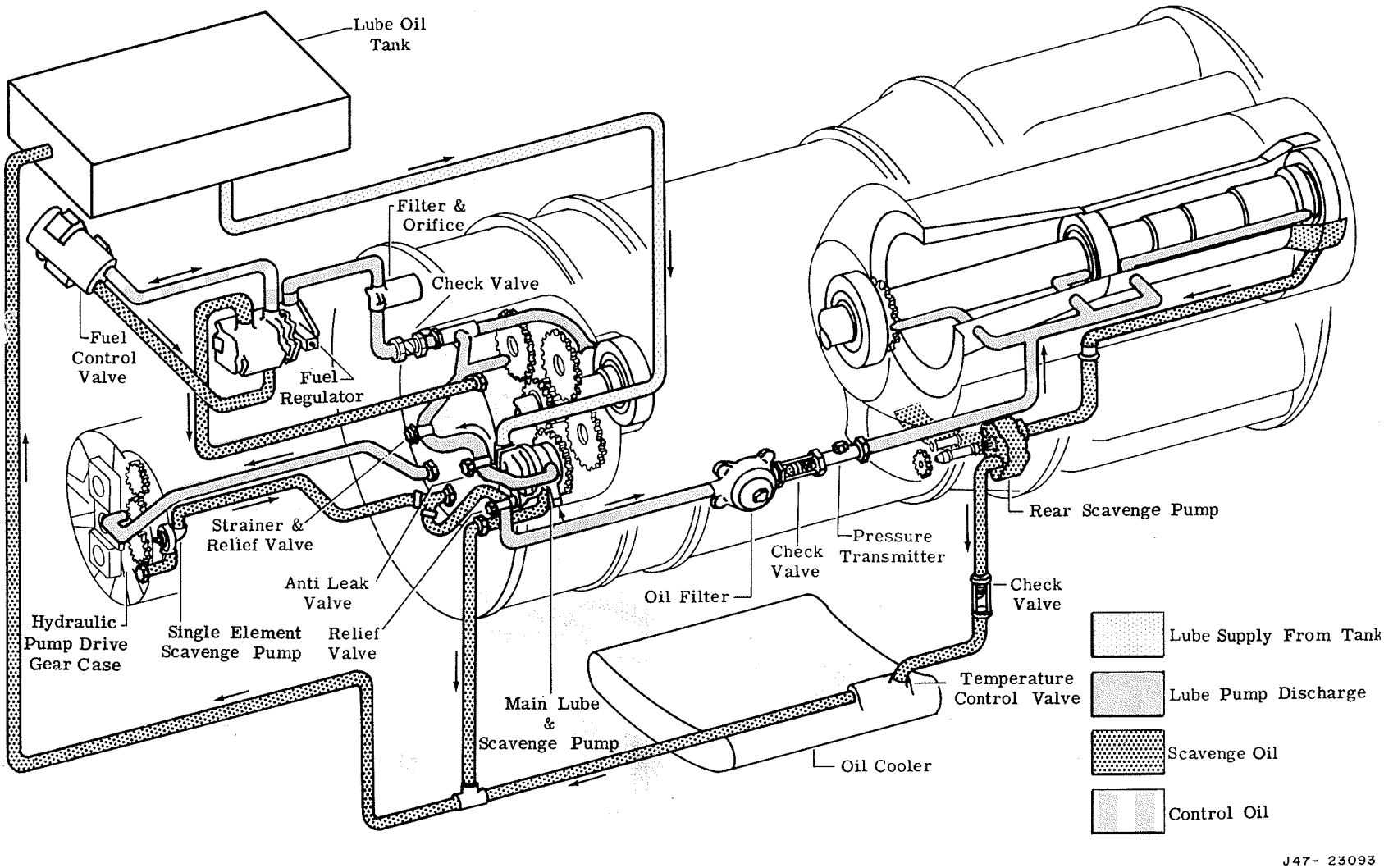


Figure 1–14. Lube Schematic, J47–27

amount of its heat to the fuel flowing through tubing within the cooler. The cooled oil then returns to the tank along with the oil scavenged from the gear case(s).

1–37. The gear case of the J47–27 engine has gears and bearings that require lubrication. The No. 2 pressure element of the main oil pump supplies this lubricating oil through a jet in the auxiliary gear case. Oil in the hydraulic pump drive gear case is scavenged through a fitting on the front frame cover by the single-element scavenge pump mounted on the rear face of the gear case and is returned to the compressor front frame. On the J47–23, –25 and –25A engines, oil is routed from the No. 2 pressure element to the bearings within the alternator drive. It drains into the compressor front frame sump and is scavenged by the main scavenge element.

1–38. FUEL SYSTEM. (See figure 1–15.) The engine fuel system consists of a fuel pump, a fuel regulator, and a stopcock, all located in the front accessory section; a fuel control valve and a fuel filter mounted on the accessory mount support; and a flow divider, fuel manifolds, and fuel nozzles, all mounted on the compressor casings and the compressor rear frame. The engine fuel control system maintains proper relationship between throttle position and engine speed and controls engine operation so that rapid throttle movements may be made under all conditions.

1–39. EMERGENCY FUEL SYSTEM (J47–27 ONLY). (See figures 1–16 and 1–17.) In addition to the normal fuel system components, there is an emergency fuel system consisting of the emergency fuel regulator, a double check valve consisting of a main fuel check valve and a check and restrictor valve, and the emergency element of the dual element fuel pump. The emergency system supplies the engine with fuel in the event of main fuel system failure.

1–40. COOLING SYSTEM. When the engine is in an airframe, excess heat is absorbed by ram air. Air enters through an annulus, surrounds the air inlet and compressor sections of the engine, and passes out the rear end of the engine compartment. Air ducted into the aft section of the fuselage or nacelle surrounds the combustion and exhaust sections of the engine and passes out the rear end of the nacelle or fuselage. The turbine wheel is cooled by air bled from the compressor. An air line from the eighth stage of the compressor directs cooling air to the front face of the turbine wheel. A second air line extracts air from the twelfth stage of the compressor and directs it into the inner exhaust cone to cool the rear face of the turbine wheel.

1–41. ANTI-ICING SYSTEM. (See figures 1–18 and 1–19.) The engine is protected against icing by hot compressor air. The island fairings, front frame struts, inlet guide vanes, and the bullet nose, all of which are subjected to the direct blast of the cold inlet air stream, are anti-iced. The bullet nose is anti-iced by compressor discharge air taken off a pad on the compressor rear frame, brought forward into a manifold, through island No. 3 and into the bullet nose. This manifold also ducts air to the 4 island fairings. The air is led into a cavity at the leading edge of the fairing and discharged into the engine air-stream through vents at the sides of the fairings. Air for the bullet nose and fairings is controlled by a pilot-operated solenoid valve which operates the valve on J47–23, –25, and –25A engines. The J47–27 uses a butterfly-type air shutoff valve actuated by a high speed motor. In all engines, a switch in the pilot's cockpit energizes or de-energizes the air valves.

1–42. The inlet guide vanes and front frame struts not covered by island fairings are anti-iced by hot air introduced into a manifold through two elbows located 180 degrees apart on the front frame. From the manifold, the hot air passes through the 37 hollow inlet guide vanes before passing into the balance-piston area. Leakage of air from balance-piston area through the first stage seal insures a continuous flow of twelfth-stage air through the guide vanes.

1–43. RETRACTABLE SCREENS. (See figures 1–18 and 1–19.) To prevent ice from forming on the screens, they must be retracted in flight. Eight actuators are spaced around the compressor front frame. The actuators are driven by a flexible shaft composed of 8 sections, each section connecting adjacent jack screws. Each actuator has a slip clutch to assure proper functioning of the remaining screens should one become inoperative. The actuator hooks over a clevis pin on the screen; the hook is moved forward or rearward by rotation of the screen jack screw, which is driven by the flexible shaft.

1–44. WATER-ALCOHOL INJECTION SYSTEM (J47–25 AND –25A ONLY). (See figure 1–20.) The primary components of this system are a tank, a turbopump, an air valve, a pressure switch, check and drain valves, an exhaust pipe tab actuator, and injection nozzles. Control is electrical, with the main control switch located in the cockpit. All components of the system, except the water-alcohol manifold and injection nozzles, the check valve just forward of the manifold, and the tab actuator, are airframe-mounted.

1–45. VENT SYSTEM. (See figure 1–21.) The vent system is designed to maintain proper pressures on the 3 air-oil seals in the engine. The No. 1 bearing air-oil seal is vented through 4 screened ports on the compressor front frame to the cooling air flowing past the engine. The No. 2 bearing seal is vented through two ports on the horizontal centerline in the rear of the compressor frame. These vents discharge into the region around the forward ends of the combustion chambers and into the cooling air flow. The No. 4 bearing is vented in a similar manner. The air is routed from the seal to 2 sets of perforations at the rear of the turbine frame forward of the combustion chamber support plate.

1–46. The No. 2 and No. 4 bearing seals, together with the turbine frame barrel, form a closed space containing lube oil vapor and air. This space has a vent, called the turbine frame breather, to prevent pressure buildup in the turbine frame, which would force oil out through the No. 4 bearing seal. The turbine frame breather is brought out between the No. 5 and 6 combustion chambers and must be provided with an aspirator so that a slight negative pressure differential exists between the turbine frame barrel and ambient nacelle pressure.

1–47. DRAIN SYSTEM. (See figure 1–22.) The drain system disposes of unused fuel in the combustion chambers and fuel and oil leakage from the accessories. Unused fuel in the combustion chambers drains through a yoke piping system which connects the forward ends of the chambers and leads to a fitting underneath the lower combustion chambers. The rear end of each chamber drains into the bottom of the turbine casing, where a drain fitting is provided. This fitting is piped to the forward combustion chamber drain so that the connection to an overboard drain may be made at either of these two points. Immediately above, and slightly forward of, the turbine casing drain, another fitting is located. This fitting can also drain the turbine casing when the engine is nose-down. This fitting is also connected to the forward drain.

1–48. Leakage from the stopcock and fuel pump is piped to a tee fitting inside the accessory gear cowling and from there through the No. 3 island fairing to an elbow on the No. 3 island cover. The emergency fuel regulator, mounted on the upper left section of the compressor casing on the J47–27 engine, drains to a tee fitting slightly aft of the No. 3 island. The flow divider, mounted on the oil cooler, has an internal drain which returns leakage fuel to the fuel inlet fitting at the No. 3 island. The drip valves drain overboard.

1–49. The accessory section is drained through a scupper, or passage into a hollow strut of the forward frame. A drain manifold on the bottom of the compressor front frame collects the leakage from the accessory section, emergency fuel regulator, stopcock, and fuel pump, and drains it overboard. The No. 1 bearing air oil seal drains into a fitting on the bottom of the compressor front frame. This drain disposes of any condensed oil vapor in the area between the labyrinth seals.

1–50. Provision is made for drainage connections for the customer-provided hydraulic pump which may be installed on the accessory drive section or on the power take-off section of the J47–27 engine. An elbow fitting on the No. 2 island cover is provided for external connections.

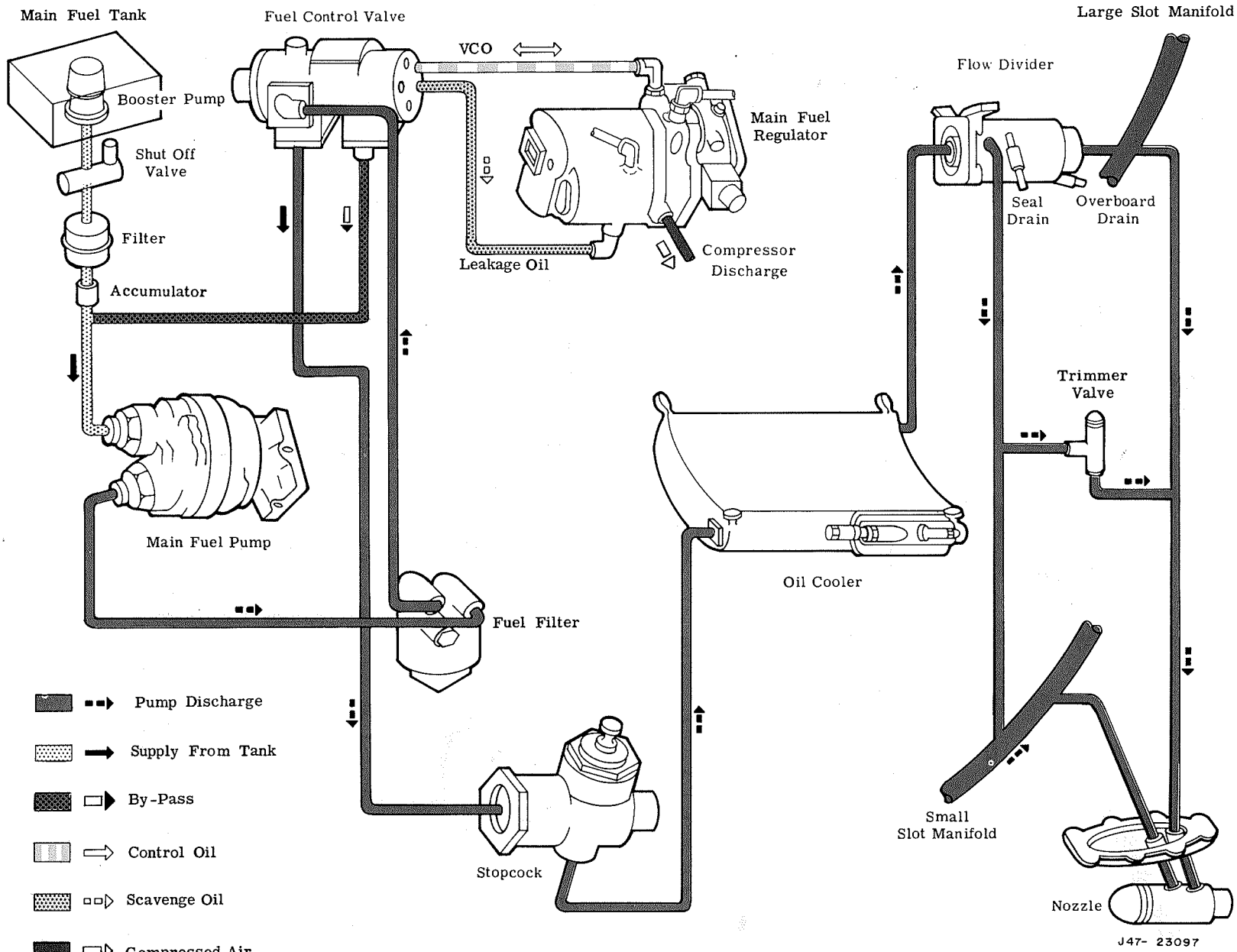


Figure 1–15. Fuel Schematic, J47–23, –25, –25A

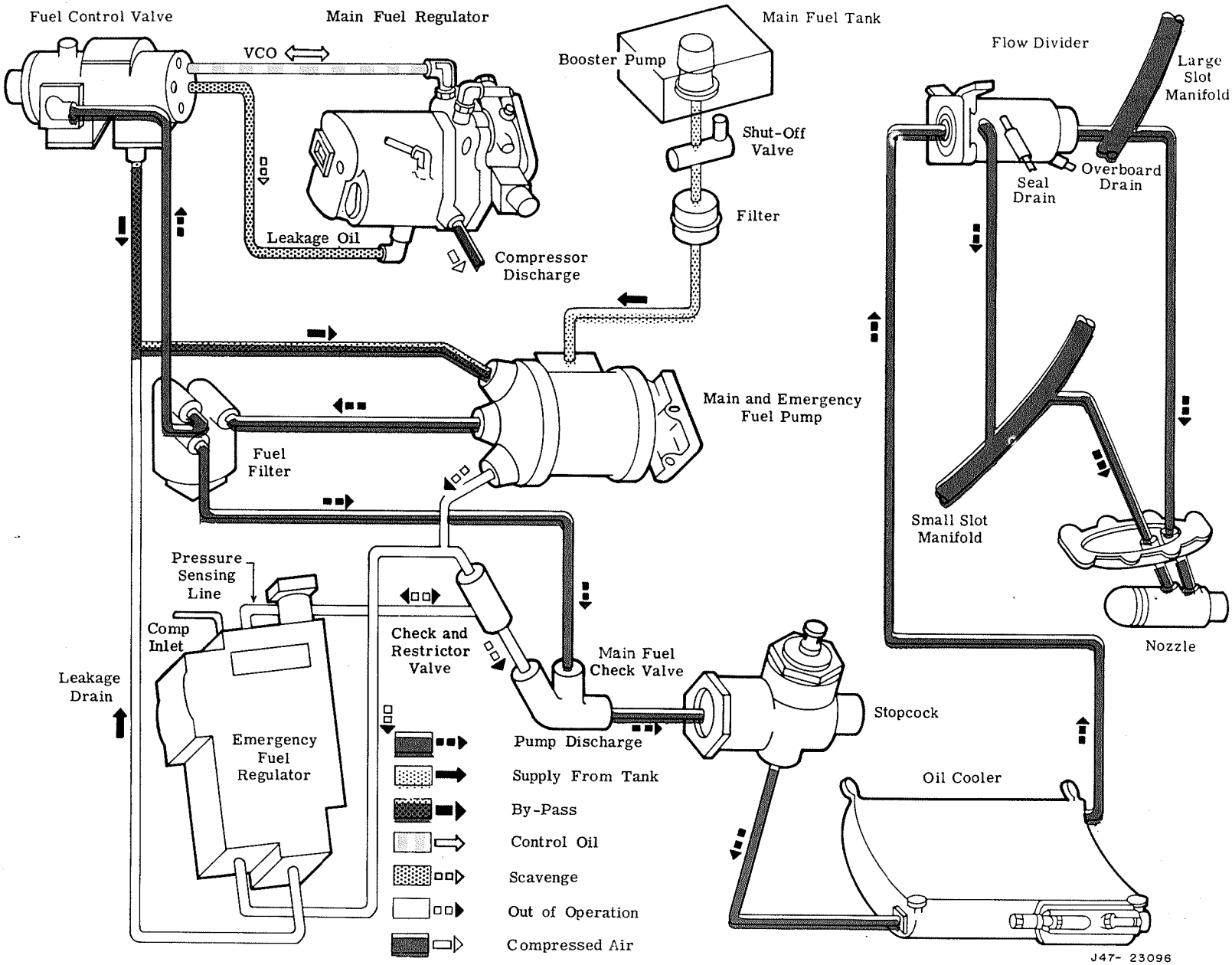


Figure 1–16. Fuel Schematic, J47–27

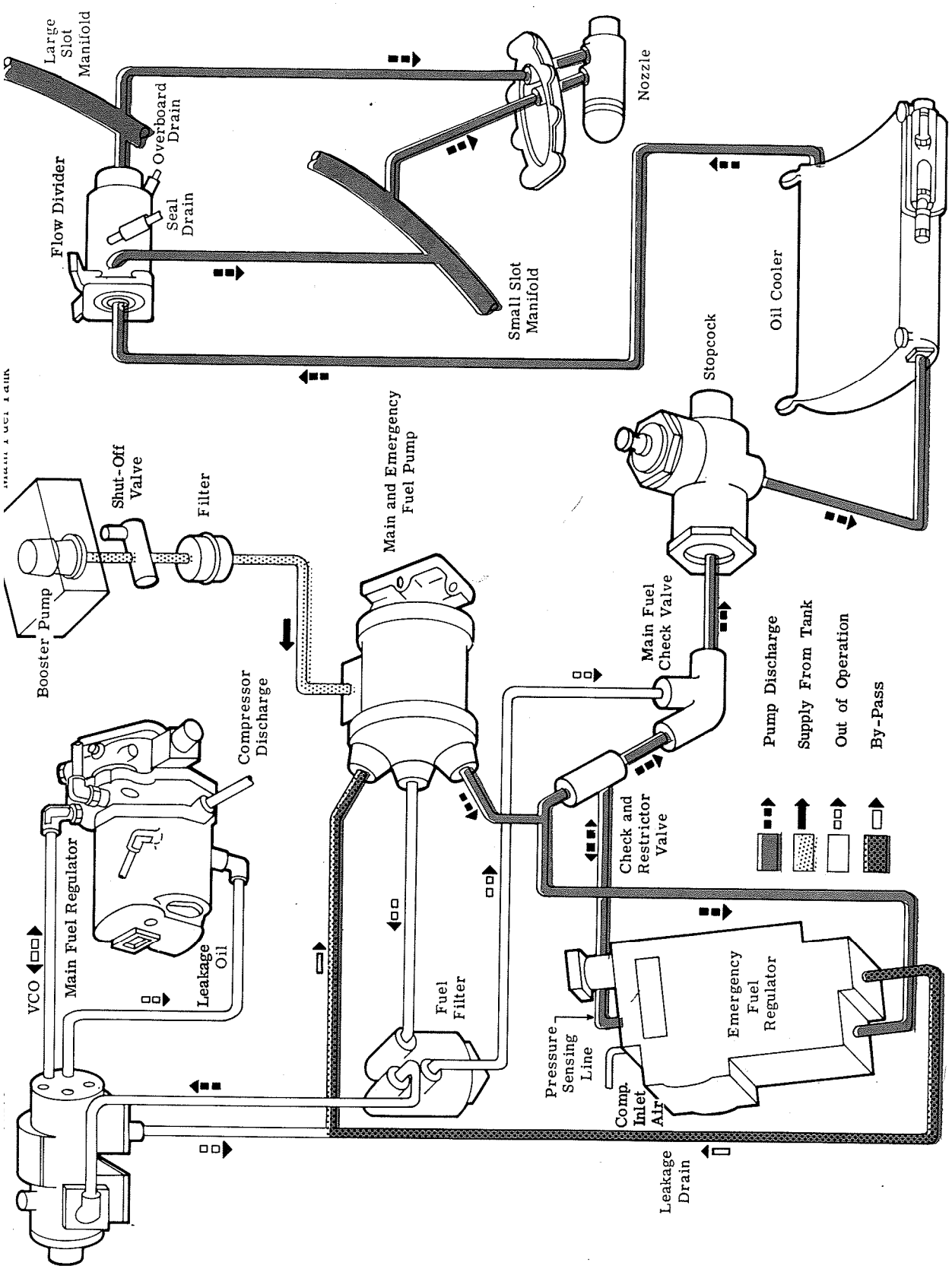
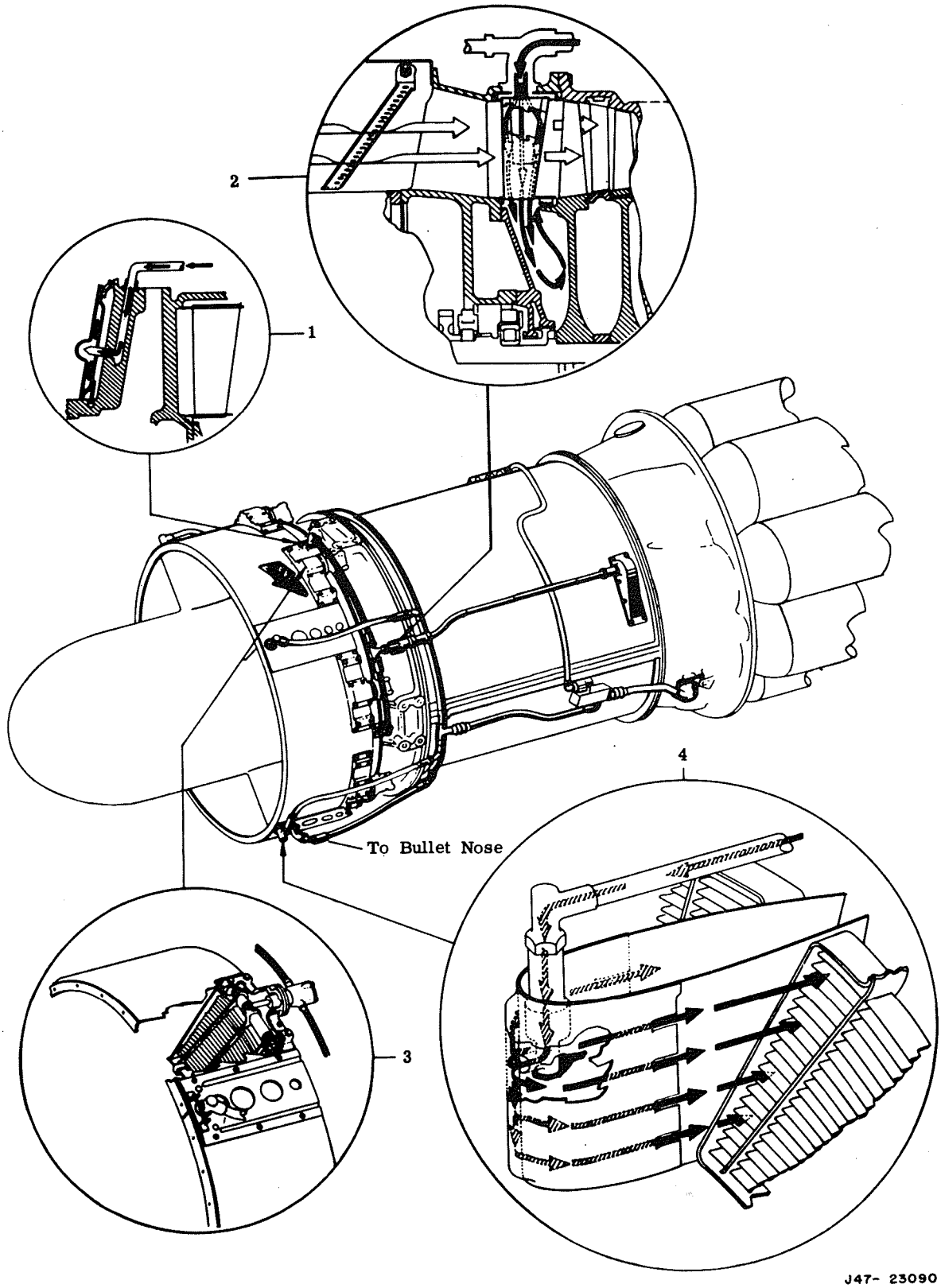
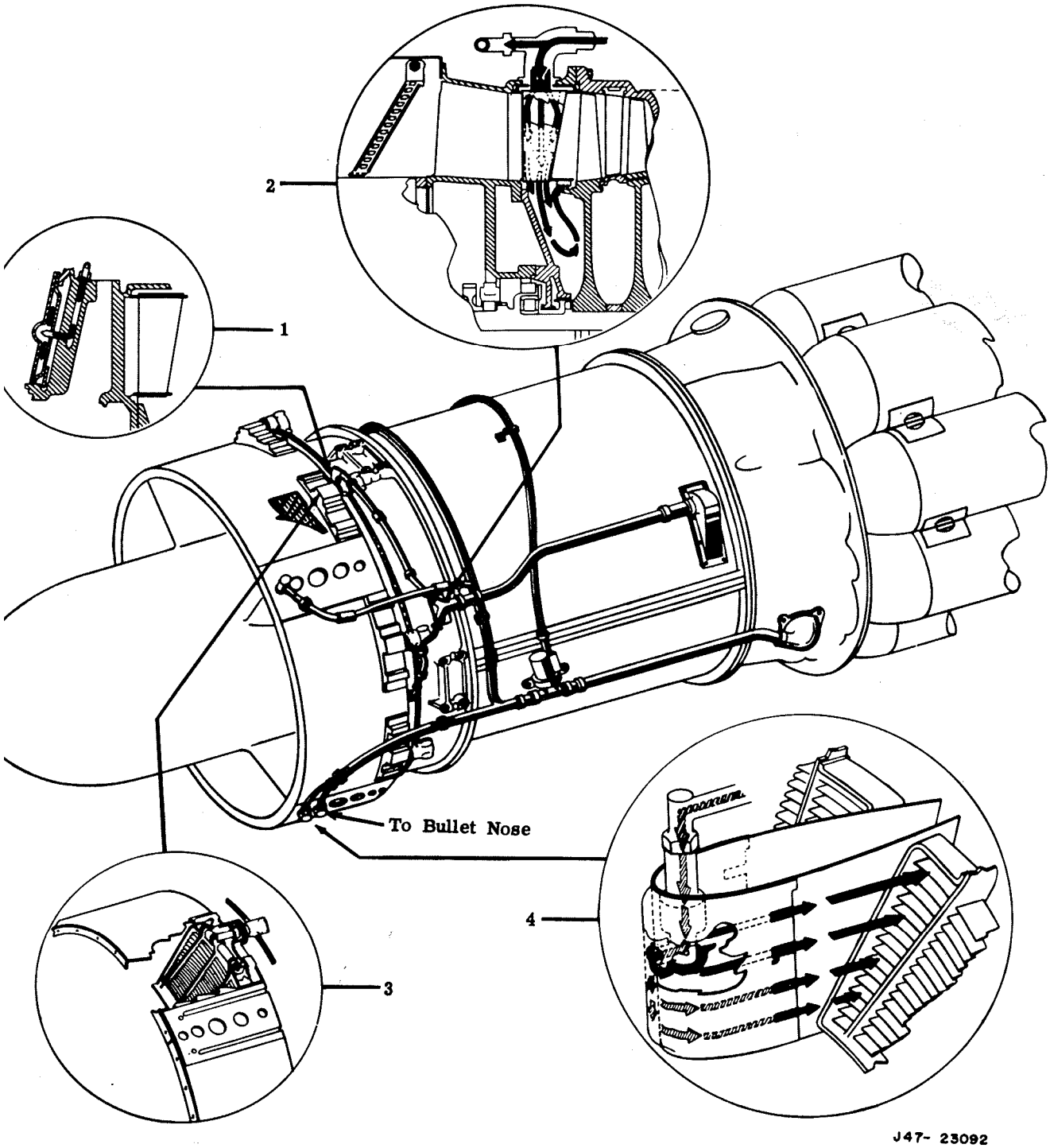


Figure 1–17. Emergency Fuel System Schematic, J47–27



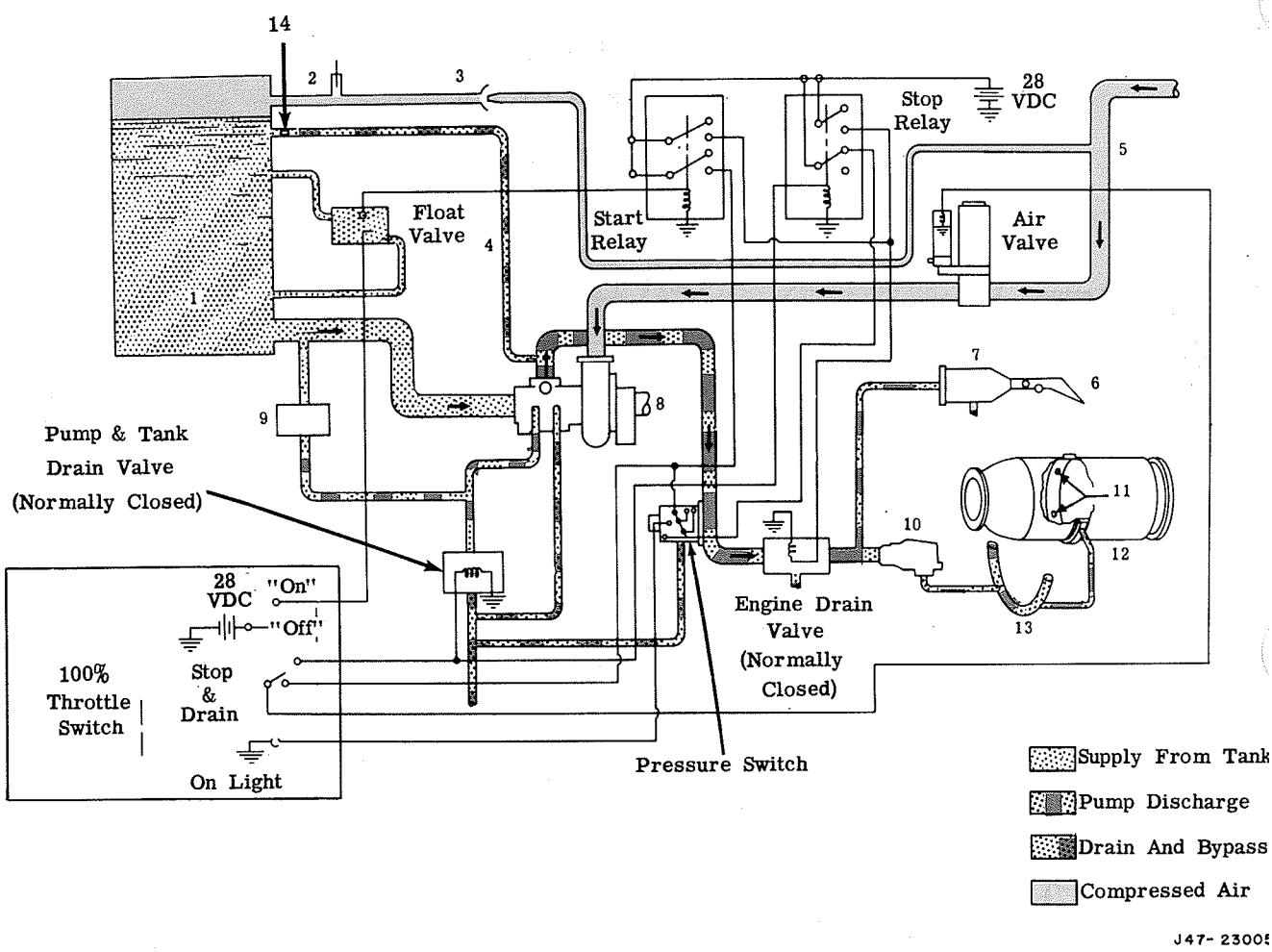
1. Front Frame Strut, Anti-Icing
2. Inlet Guide Vane, Anti-Icing
3. Retractable Screen
4. Island Fairing, Anti-Icing

Figure 1–18. Anti-Icing System, J47–23, –25, –25A



1. Front Frame Strut, Anti-Icing
2. Inlet Guide Vane, Anti-Icing
3. Retractable Screen
4. Island Fairing, Anti-Icing

Figure 1–19. Anti-Icing System, J47–27



1. Water-Alcohol and Fuel Tank
2. Relief Valve
3. Pump Priming Line
4. Pump Bleed Line
5. Pressurized Air Line
6. Tab
7. Tab Actuator
8. Injection Turbo-Pump
9. Check Valve
10. Check Valve
11. Nozzles
12. Combustion Chamber Manifolds
13. Injection Manifolds
14. Restricting Orifice

Figure 1–20. Water-Alcohol Injection System

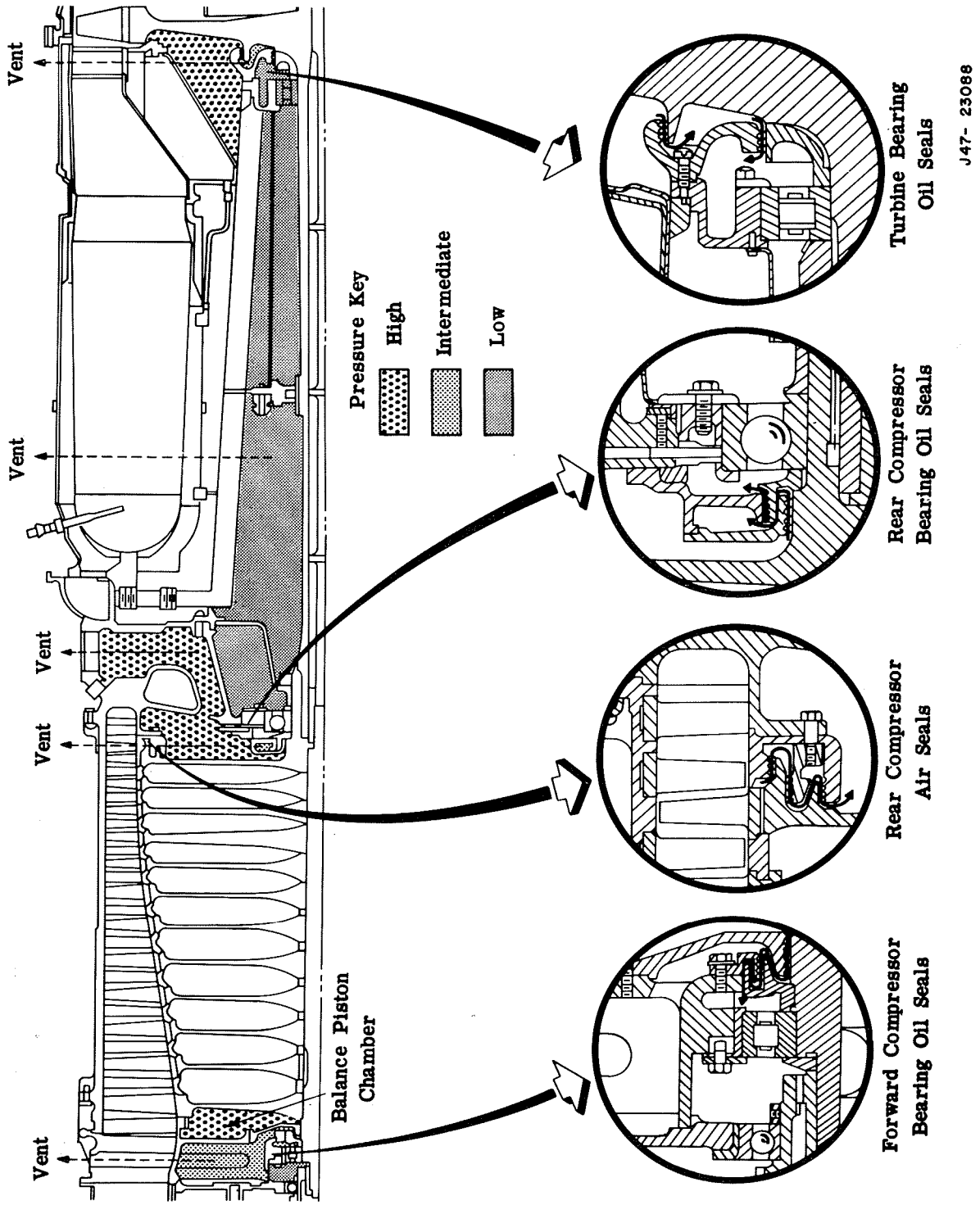
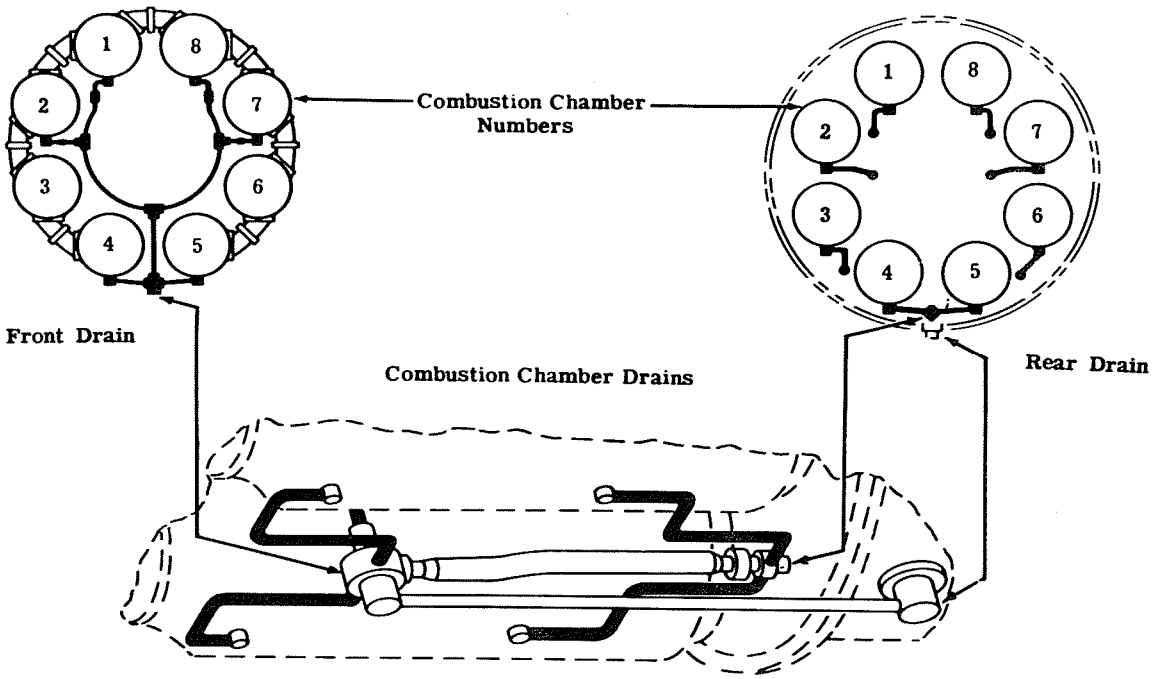
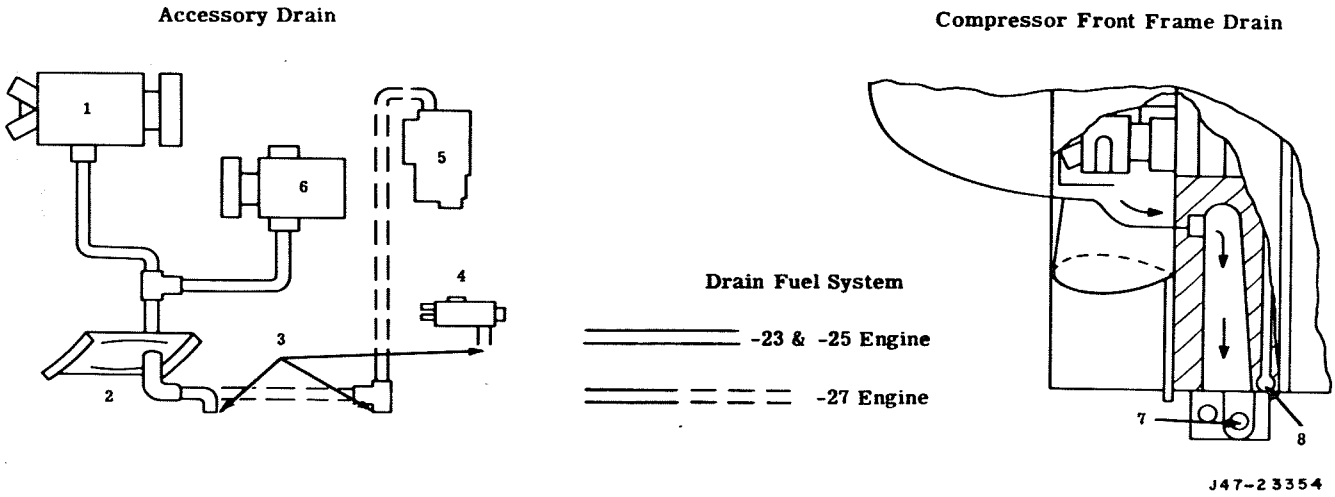


Figure 1–21. Air Flow through Seals and Vents





1. Fuel Pump
2. No. 3 Island
3. Flow Divider
4. Flow Divider
5. Emergency Regulator
6. Stopcock
7. Drain Fitting
8. Seal Drain

Figure 1–22. Drain System Schematic

SECTION II

TOOLS

2-1. GENERAL.

2-2. This section contains 2 tables of the special tools needed to do the work prescribed by this handbook. In one table, the tools needed for particular operations are grouped together. These functional groups are in alphabetical order and are referred to in other sections of the book by a tool group number. In the other table, tools are in numerical order by the part numbers which appear on the tools. The USAF stock number, consisting of the class code and the part number, is also given in the numerical list. These numbers may be used as an aid in procuring special tools.

2-3. Use hammers with plastic or rawhide (never metal) heads when driving on any part of the engine. Never lift heavy parts by hand; use a chain or powered hoist and special lifting yokes. Apply pressure or tension evenly to all bearing pushers or pullers. Tighten jackscrews and attaching screws, bolts, and nuts in small increments at opposite points.

TABLE III. FUNCTIONAL TOOL GROUP LIST

Group No.	Function and Tools	Tool No.	Figure No.
1.	Accessory Installation to Front Frame		
	Stand — Compressor front frame assembly	1C817	5-15
	Bracket — Compressor front frame	1C619-59	5-15
	Bracket — Compressor front frame and assembly lifting	1C810	5-15
2.	Deleted		
3.	Alternator Mount Installation		
	Pusher puller — Front frame coupling	1C785	3-8
	Pliers — Snap ring	1C899	2-9
4.	Combustion Chamber Installation		
	Clamp — Combustion chamber bellows compressing	1C988	6-12
	Clamp — Combustion chamber bellows expanding	1C989	6-13
	Lever — Cross-ignition clamp assembly	1C2227	6-13
5.	Compressor Front Frame Assembly		
	Pusher — No. 1 bearing outer race and main accessory drive bearing	1C842	5-36
6.	Compressor Front Frame Installation to Compressor Section		
	Lifting Bracket — Engine assembly	1C2037	6-27
	Sling — Engine assembly	1C2043	6-27
	Pilot — Compressor rotor to front frame, vertical	1C2027	6-28
	Guide — Compressor rotor pilot to front frame vertical	1C2028	6-28
	Platform — Compressor stator casing removal	1C2035-3	6-29
	Spreader Bar — Stator casing removal	1C2035-2	6-29
7.	Compressor Front Frame Installation into Disassembly Stand		
	Eye Pad — Compressor front frame lifting	1C645	2-2
	Bracket — Vertical assembly stand	1C2153	6-16
	Sling — Compressor lifting	1C808	2-7
	Stand — Engine assembly and disassembly	1C2030	3-7
	Stand — Compressor front frame assembly	1C817	3-23
	Bracket — Compressor front frame lifting	1C810	3-23
	Bracket — Compressor front frame	1C619-59	3-23

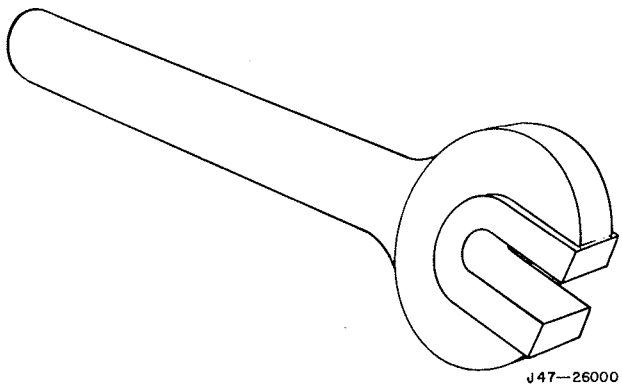


Figure 2–1. Turbine Rotor Shaft Bolt Wrench 3177

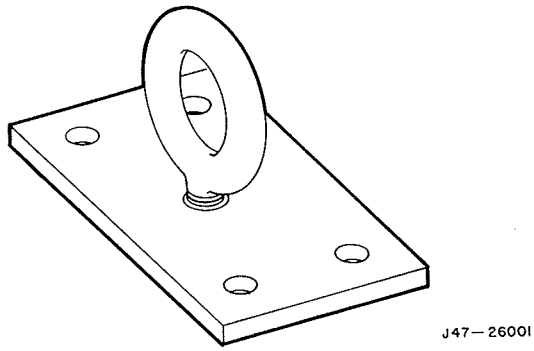


Figure 2–2. Compressor Front Frame Lifting Eye Pad 1C645

TABLE III. FUNCTIONAL TOOL GROUP LIST (cont)

Group No.	Function and Tools	Tool No.	Figure No.
8.	Compressor Front Frame Installation into Engine Assembly Stand		
	Stand—Compressor front frame assembly	1C817	3–23
	Stand—Engine assembly and disassembly	1C2030	6–16
	Eye pad—Compressor front frame lifting	1C645	2–2
	Bracket—Vertical assembly stand	1C2153	6–16
	Sling—Compressor lifting	1C808	2–7
	Bracket—Compressor front frame	1C619–59	6–16
9.	Compressor Front Frame Disassembly		
	Jackscrew—No. 1 bearing oil seal	1C906	2–10
	Jackscrew—No. 1 bearing housing	1C839	3–32
	Pusher—No. 1 bearing outer race and main accessory drive bearing	1C842	3–33
10.	Compressor Front Frame Removal from Compressor Section		
	Sling—Engine assembly	1C2043	3–22
	Lifting Bracket—Engine assembly	1C2037	3–22
	Guide—Compressor rotor pilot to front frame vertical	1C2028	3–21
	Pilot—Compressor rotor to front frame vertical	1C2027	3–21
11.	Compressor Rotor Installation into Assembly Stand		
	Driver—No. 1 bearing inner race	1C789	6–18
	Wrench—No. 1 bearing locknut	1C783	6–19
	Sling—Stator casing vertical	1C2025	6–21
12.	Deleted		
13.	Compressor Rotor Clearance Measurement		
	Gage—Compressor rotor clearance	1C831	6–30
14.	Deleted		
15.	Compressor Rear Frame Assembly		
	Pusher puller transfer tube	1C2047	
	Pusher puller lube inlet transfer tube	1C2276	
16.	Compressor Rear Frame Disassembly		
	Pusher puller transfer tube	1C2047	
	Pusher puller lube inlet transfer tube	1C2276	

TABLE III. FUNCTIONAL TOOL GROUP LIST (cont)

Group No.	Function and Tools	Tool No.	Figure No.
17.	Deleted		
18.	Compressor Rear Frame Disassembly from Rotor and Stators		
	Puller—No. 2 bearing and scavenge pump drive pinion	1C616	3–25
	Sling—Stator casing vertical and horizontal	1C2025	3–28
	Wrench—No. 1 bearing locknut	1C783	3–30
	Puller—No. 1 bearing inner race and seal	1C784	3–31
19.	Engine Disassembly Preparations		
	Pliers—Snap-ring	1C899	2–9
	Pusher puller—Compressor front frame coupling	1C785	3–8
	Pilot—Compressor rotor to front frame vertical	1C2027	3–21
20.	Engine Disassembly Preparations (Horizontal)		
	Stand—Engine transportation	M–2	2–22
	Bracket—Compressor front frame	1C619–59	3–23
21.	Engine Disassembly Preparations (Vertical)		
	Stand—Engine assembly and disassembly	1C2030	3–7
	Stand—Engine transportation	M–2	2–22
	Eye—Engine lifting	1C981	6–51
	Eye—Engine lifting	1C686	2–4
	Lifting bracket—Engine assembly	1C2037	3–7
	Bracket—Compressor front frame	1C619–59	3–7
	Auxiliary engine support—Aft end	1C2187	3–7
	Sling—Engine assembly	1C2043	3–7
	Bracket—Vertical assembly stand	1C2153	3–7

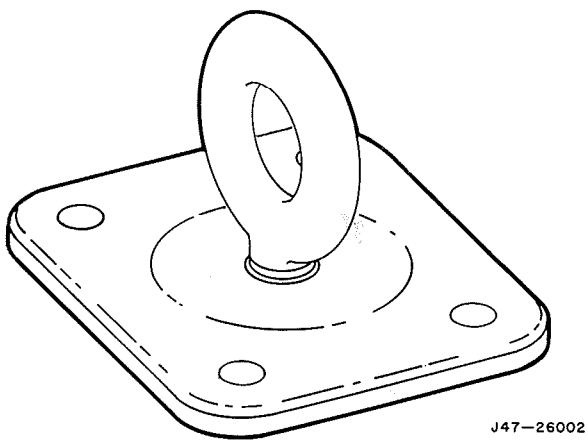


Figure 2–3. Compressor Rear Frame Lifting Eye Pad 1C646

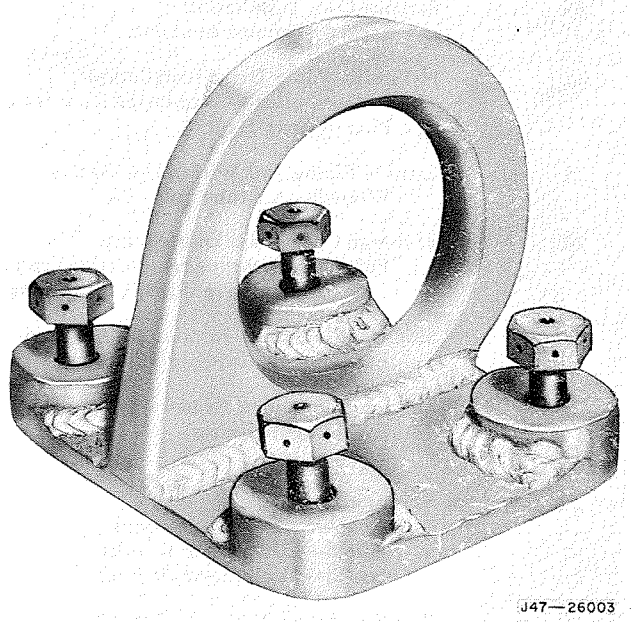


Figure 2–4. Engine Lifting Eye 1C686

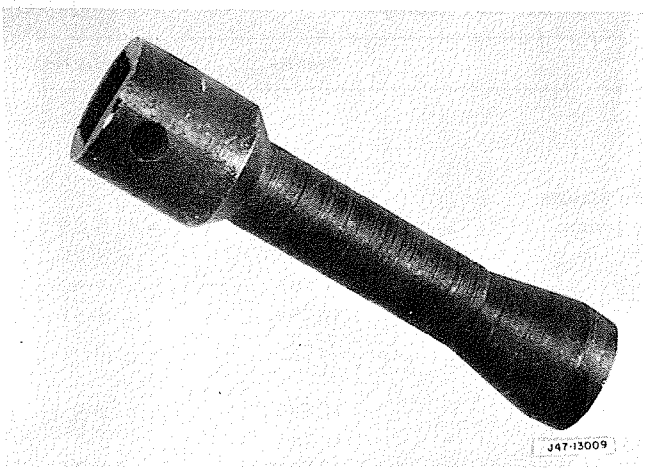


Figure 2-5. Exhaust Cone Nut Socket 1C711

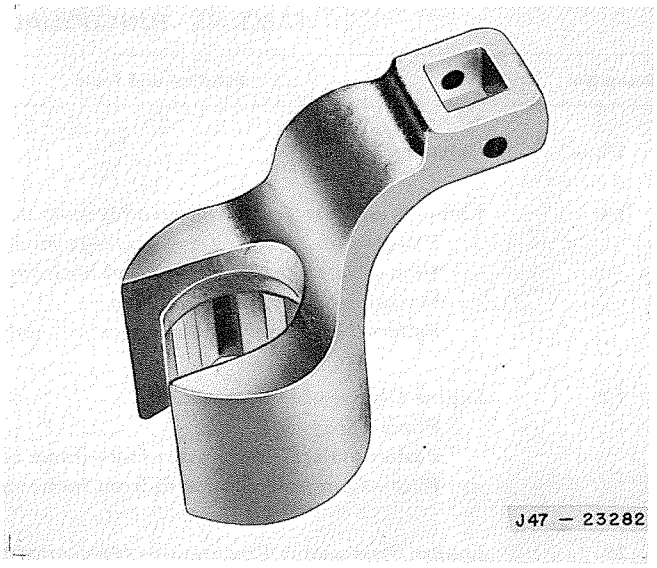


Figure 2-6. Air Tube Nut Wrench 1C723

TABLE III. FUNCTIONAL TOOL GROUP LIST (cont)

Group No.	Function and Tools	Tool No.	Figure No.
21 (cont)	Engine Disassembly Preparation (Vertical) (cont)		
	Adapter—Turbine shaft bolt torquing	1C2036	3-16
	Wrench—Turbine wheel holding	1C695	6-9
	Wrench—Turbine rotor shaft bolt	3177	2-1
	Driver—Turbine rotor tie-bolt, assembly & disassembly	1C2039	3-10
	Lift—Turbine rotor	1C980	3-11
22.	Dummy Hydraulic Pump Casing Installation		
	Fixture—Fuel control valve positioning	1C2284	*
23.	Exhaust Cone Installation		
	Socket—Exhaust cone nut	1C711	2-5
24.	Hydraulic Pump Drive Installation		
	Pusher puller—Compressor front frame coupling	1C785	6-41
	Pliers—Snap-ring	1C899	2-9
25.	Outside Piping and Wiring Installation		
	Wrench—Air tube nut	1C723	2-6
26.	Scavenge Gear Train Disassembly		
	Puller—Screw type rear bearings and first and second reduction gear drive shaft disassembling	1C602	3-37
27.	Shipping Container, Installation of Engine		
	Eye—Engine lifting	1C981	6-51
28.	Shipping Container, Removal of Engine		
	Eye—Engine lifting	1C981	3-1
	Eye—Engine lifting	1C686	2-4
29.	Slushing Procedure		
	Adapter—Engine motoring	1C2044	2-17
	Shield—Compressor air inlet	1C2053-1	2-18
	Shield—Compressor air inlet	1C2053-2	2-18
30.	Test Stand, Installation of Engine		
	Eye—Engine lifting	1C981	6-51
	Dolly—Engine test	1C1640	2-14

*Illustration will be supplied in a later revision

TABLE III. FUNCTIONAL TOOL GROUP LIST (cont)

Group No.	Function and Tools	Tool No.	Figure No.
31.	Test Stand, Removal of Engine		
	Dolly—Engine test	1C1640	2–14
	Eye—Engine lifting	1C981	6–51
	Eye—Engine lifting	1C686	2–4
	Bracket—Compressor front frame	1C619–59	3–23
	Stand—Engine transportation	M–2	2–22
32.	Testing After Repair		
	Tailpipe—Test	1C728	7–8
	Adapter—Nose fairing	1C1617	2–13
	Thermocouple and harness assembly—Bellmouth	1C1633	7–10
	Bellmouth—General assembly	1C825	7–1
	Nose fairing—Engine test	1C891	7–1
	Aspirator, Aft Frame Vent	1C1707	7–18
	Test Set	1C1749	7–16A
33.	Transferring Engine from Horizontal to Vertical Position		
	Stand—Engine transportation	M–2	2–22
	Eye pad—Compressor front frame lifting	1C645	2–2
	Eye pad—Compressor rear frame lifting	1C646	2–3
	Sling—Compressor assembly lifting	1C809	2–8
	Stand—Engine assembly and disassembly	1C2030	3–7
	Bracket—Engine assembly lifting	1C2037	3–7
	Bracket—Compressor front frame	1C619–59	3–23
	Sling—Engine assembly	1C2043	3–7
	Bracket—Vertical assembly stand	1C2153	6–16
34.	Transferring Engine from Vertical to Horizontal Position		
	Sling—Engine assembly	1C2043	6–46
	Bracket—Engine assembly lifting	1C2037	6–46
	Bracket—Vertical assembly stand	1C2153	6–47
	Stand—Engine transportation	M–2	2–22
	Stand—Engine assembly and disassembly	1C2030	6–46
	Auxiliary engine support—Aft end	1C2187	6–47

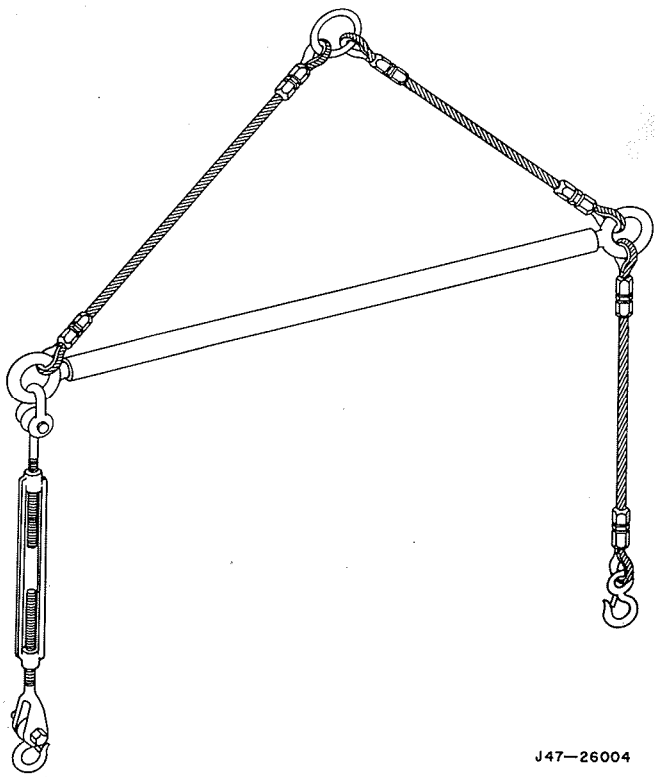


Figure 2–7. Compressor Lifting Sling 1C808

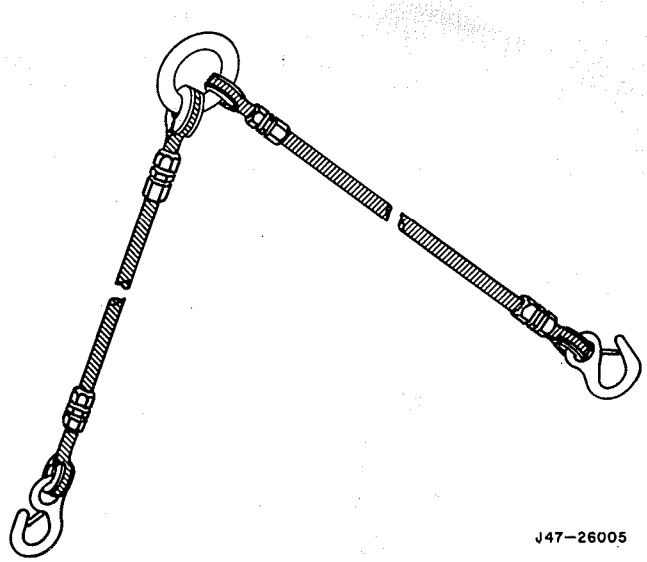


Figure 2–8. Compressor Assembly Lifting Sling 1C809

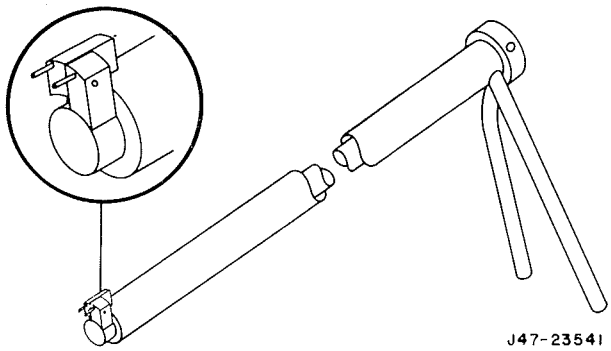


Figure 2-9. Snap Ring Pliers 1C899

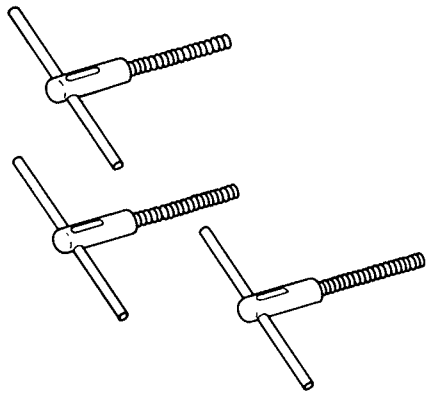


Figure 2-10. No. 1 Bearing Oil Seal Jackscrew 1C906

TABLE III. FUNCTIONAL TOOL GROUP LIST (cont)

Group No.	Function and Tools	Tool No.	Figure No.
35.	Throttle Linkage Adjustment		
	Gage set—Adjustable linkage assembly	1C2228	2-21
36.	Turbine Frame Assembly		
	Stand—Turbine frame assembly	1C632	5-55
	Sling—Turbine frame lifting	1C896	3-13
	Gage set—No. 4 bearing oil jet aligning	1C772	5-58
	Fixture—No. 3 bearing oil jet aligning	1C771	5-64
37.	Turbine Frame Disassembly		
	Stand—Turbine frame assembly	1C632	3-41
	Protector—Aft bearing air and oil seal	1C2014	2-15
	Puller—No. 4 bearing outer race	1C367	3-42
38.	Turbine Frame Installation (Horizontal)		
	Stand—Turbine frame assembly	1C632	3-41
	Sling—Turbine frame horizontal lifting	1C896	3-13
	Gage set—No. 2 bearing oil jet aligning	1C773	6-5
	Driver—Turbine rotor tie-bolt assembly and disassembly	1C2039	6-8
	Adapter—Turbine tie-bolt torquing	1C985	6-9
	Adapter—Turbine shaft bolt torquing	1C2036	6-8
	Wrench—Turbine rotor holding	1C695	6-9
39.	Turbine Frame Installation (Vertical)		
	Sling—Turbine frame and wheel vertical	1C2033	6-36
	Gage set—No. 2 bearing oil jet aligning	1C773	6-38
	Guide—Turbine frame aligning, vertical	1C2040	2-16
	Adapter—Turbine shaft bolt torquing	1C2036	6-40
	Driver—Turbine rotor tie-bolt assembly and disassembly	1C2039	6-40
40.	Turbine Frame and Combustion Chamber Removal (Horizontal)		
	Wrench—Air tube nut	1C723	2-6
	Hook—Cross-ignition clamp disassembly	1C2226	2-20
	Clamp—Combustion chamber bellows compressing	1C988	3-9
	Sling—Turbine frame lifting, horizontal	1C896	3-13
	Stand—Turbine frame assembly	1C632	3-14
41.	Turbine Frame and Combustion Chamber Removal (Vertical)		
	Wrench—Air tube nut	1C723	2-6
	Hook—Cross-ignition clamp disassembly	1C2226	2-20
	Clamp—Combustion chamber bellows compressing	1C988	3-17
42.	Turbine Rotor Assembly		
	Lift—Turbine rotor	1C980	5-80
	Wrench—No. 4 bearing locknut	1C667	5-81
	Wrench—No. 3 bearing locknut	1C668	5-82

TABLE III. FUNCTIONAL TOOL GROUP LIST (cont)

Group No.	Function and Tools	Tool No.	Figure No.
43.	Turbine Rotor Disassembly		
	Lift—Turbine rotor	1C980	3–11
	Wrench—No. 3 bearing locknut	1C668	3–43
	Puller—No. 3 and No. 4 bearing inner race hydraulic	1C986	3–44
	Wrench—No. 4 bearing locknut	1C667	3–45
	Stand—Turbine rotor assembly	1C982	3–20
44.	Turbine Rotor Installation (Horizontal)		
	Lift—Turbine rotor	1C980	3–11
	Stand—Turbine rotor assembly	1C982	3–20
	Stand—Turbine frame assembly	1C632	3–41
	Clamp—Turbine rotor to turbine frame	1C883	6–3
45.	Turbine Rotor Installation (Vertical)		
	Stand—Turbine rotor assembly	1C982	3–20
	Lift—Turbine rotor	1C980	3–11
	Stand—Turbine frame assembly	1C632	3–41
	Clamp—Turbine rotor to turbine frame	1C883	6–34
	Spacer—Turbine tie-bolt	1C2217	2–19
	Sling—Turbine frame and turbine wheel, vertical	1C2033	6–36
46.	Turbine Rotor Removal from Engine (Horizontal)		
	Wrench—Turbine wheel holding	1C695	6–9
	Adapter—Turbine tie-bolt torquing	1C2036	3–10
	Wrench—Turbine rotor shaft bolt	3177	2–1
	Driver—Turbine wheel tie-bolt assembly and disassembly	1C2039	3–10
	Lift—Turbine rotor	1C980	3–11
	Guard—Turbine wheel buckets protecting	1C606	3–12
	Protector—Inner race bearing No. 4	1C691	3–12
	Protector—Inner bearing No. 3	1C687	3–12
	Stand—Turbine rotor assembly	1C982	3–15
	Protector—Aft bearing air and oil seal	1C2014	2–15
	Protector—Turbine rotor tie-bolt thread	1C973	2–11

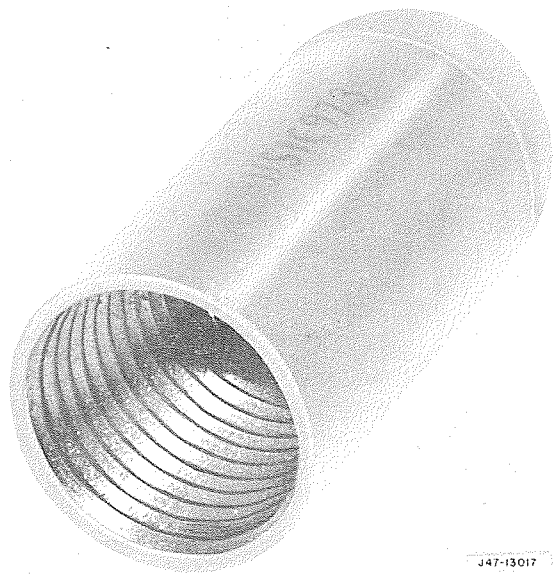


Figure 2–11. Turbine Wheel Tie Bolt Thread Protector 1C973

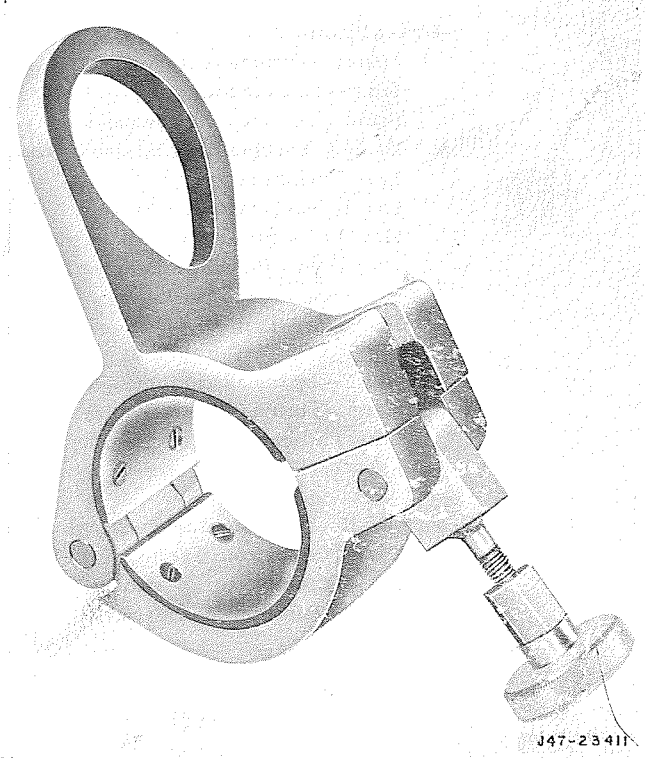


Figure 2–12. Turbine Rotor Lift 1C983

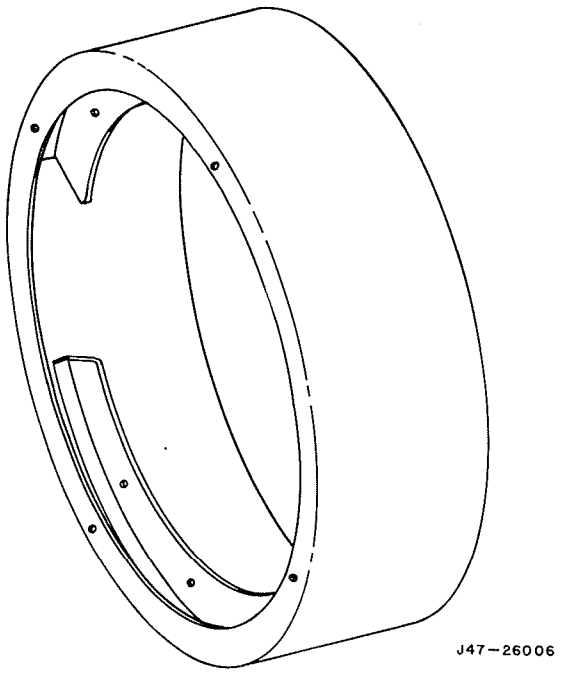


Figure 2-13. Nose Fairing Adapter 1C1617

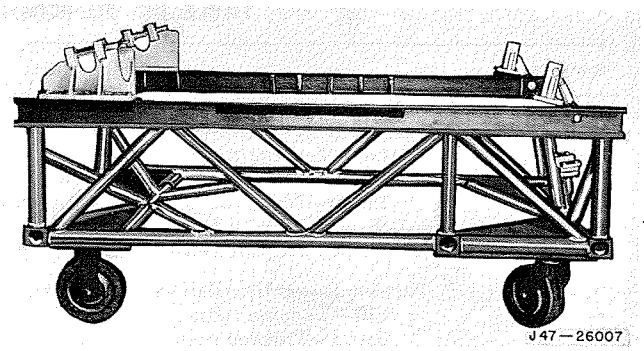


Figure 2-14. Engine Test Dolly 1C1640

TABLE III. FUNCTIONAL TOOL GROUP LIST (cont)

Group No.	Function and Tools	Tool No.	Figure No.
47.	Turbine Rotor Removal from Engine (Vertical)		
	Spacer—Turbine bolt, vertical	1C2217	2-19
	Sling—Turbine frame and turbine rotor vertical	1C2033	3-18
	Stand—Turbine frame assembly	1C632	3-14
	Clamp—Turbine rotor to turbine frame	1C883	3-19
	Lift—Turbine rotor	1C980	3-11
	Stand—Turbine rotor assembly	1C982	3-20
	Guard—Turbine rotor buckets protecting	1C606	3-12
	Protectors—Inner race bearing No. 4	1C691	3-12
	Protector—Inner bearing No. 3	1C687	3-12
	Protector—Turbine wheel tie-bolt thread	1C973	2-11
48.	Turbine Rotor Installation into Shipping Container		
	Stand—Turbine rotor assembly	1C982	3-20
	Lift—Turbine rotor, horizontal	1C983	2-12
	Lift—Turbine rotor, vertical	1C987	6-54
49.	Turbine Rotor Removal from Shipping Container		
	Lift—Turbine rotor, vertical	1C987	6-54
	Lift—Turbine rotor, horizontal	1C983	2-12
	Stand—Turbine rotor assembly	1C982	3-20

TABLE IV. NUMERICAL TOOL LIST

USAF Stock No. Class Code	Tool No.	Nomenclature	Group No.	Figure No.
9AAD	3177	Wrench—Turbine rotor tie-bolt	21, 46	2–1
9AGE	1C367	Puller—No. 4 bearing outer race	37	3–42
9AGE	1C602	Puller—Screw type rear bearings and first and second reduction gear drive shaft disassembly	26	3–37
9AGE	1C606	Guard—Turbine rotor bucket protecting	46,47	3–12
9AGE	1C616	Puller—Scavenge pump drive pinion and No. 2 bearing	18	3–25
9AGE	1C619–59	Bracket—Compressor front frame	1, 7, 8, 20, 21, 31, 33	3–6, 3–7, 3–23, 6–15, 6–16, 6–47
8025	1C632	Stand—Turbine frame assembly	36, 37, 38, 40, 44, 45, 47	3–15, 3–41, 5–55,
8220 019500	1C645	Eye Pad—Compressor front frame lifting	7, 8, 33	2–2, 6–15
8220 019800	1C646	Eye Pad—Compressor rear frame lifting	33	2–3
9AGE	1C667	Wrench—No. 4 bearing locknut	42, 43	3–45, 5–81
9AGE	1C668	Wrench—No. 3 bearing locknut	42, 43	3–43, 5–82

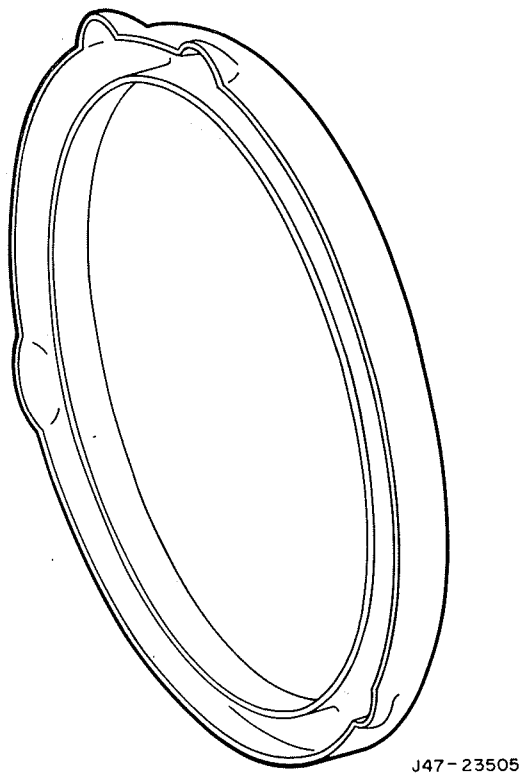


Figure 2–15. Aft Bearing Air and Oil Seal Protector 1C2014

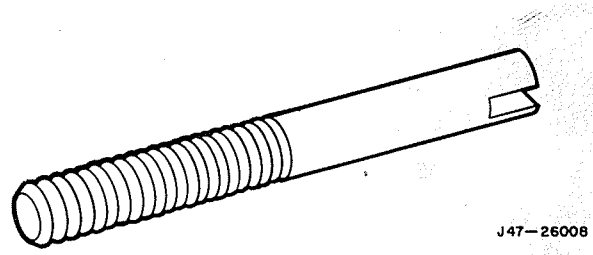


Figure 2–16. Turbine Frame Aligning Guide 1C2040

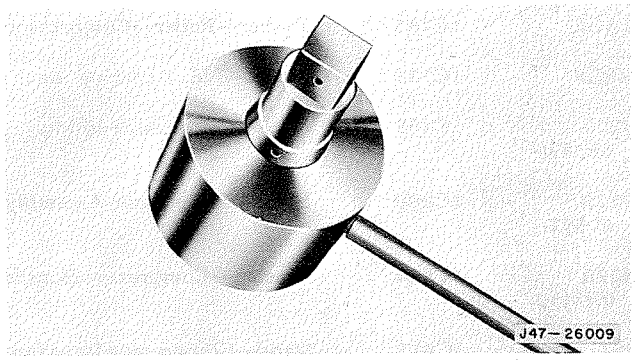


Figure 2–17. Engine Motoring Adapter 1C2044

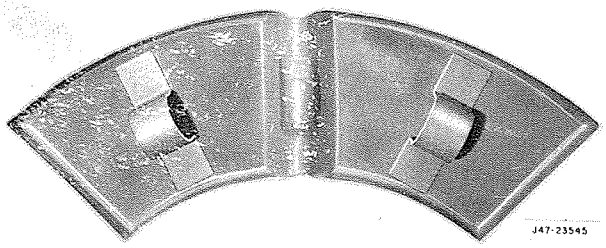


Figure 2–18. Compressor Air Inlet Shield 1C2053

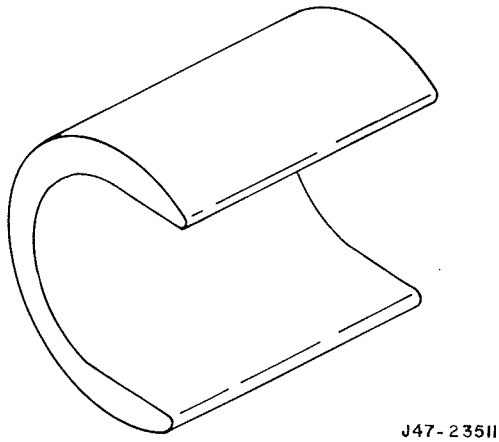


Figure 2–19. Turbine Bolt Spacer 1C2217

TABLE IV. NUMERICAL TOOL LIST (cont)

USAF Stock No. Class Code	Tool No.	Nomenclature	Group No.	Figure No.
8220 012600	1C686	Eye—Engine lifting	21, 28, 31	2–4
9AGE	1C687	Protector—Inner bearing No. 3	46, 47	3–12
9AGE	1C691	Protector—Inner race bearing No. 4	46, 47	3–12
9AGE	1C695	Wrench—Turbine wheel holding	21, 38, 46	3–16, 6–9
9AGE	1C711	Socket—Exhaust cone nut	23	2–5
9AGE	1C723	Wrench—Air tube nut	25, 40, 41	2–6
7CGE	1C728	Tailpipe—Test	32	7–8
9AGE	1C771	Fixture—No. 3 bearing oil jet aligning	36	5–64
9AGE	1C772	Gage Set—No. 4 bearing oil jet aligning	36	5–57, 5–58, 5–60, 5–61
9AGE	1C773	Gage Set—No. 2 bearing oil jet aligning	38, 39	6–5, 6–38
9AGE	1C783	Wrench—No. 1 bearing locknut	11, 18	3–30, 6–19
9AGE	1C784	Puller—No. 1 bearing inner race and oil deflector	18	3–31
9AGE	1C785	Pusher—Puller—Compressor front frame coupling	3, 19, 24	3–8, 6–41
9AGE	1C789	Driver—No. 1 bearing inner race	11	6–18
8220 603525	1C808	Sling—Compressor lifting	7, 8	2–7
8220 603526	1C809	Sling—Compressor Assembly lifting	33	2–8
8220 019450	1C810	Bracket—Compressor front frame assembly lifting	1, 7	3–23, 5–15
9AGE	1C817	Stand—Compressor front frame assembly	1, 7, 8	3–23, 5–15
7CAD 805645	1C825	Bellmouth—General assembly	32	7–1

TABLE IV. NUMERICAL TOOL LIST (cont)

USAF Stock No. Class Code	Tool No.	Nomenclature	Group No.	Figure No.
9AGE	1C831	Gage—Compressor rotor clearance	13	6-30
9AGE	1C839	Jackscrew—No. 1 bearing housing	9	3-32
9AGE	1C842	Pusher—No. 1 bearing outer race and main accessory drive bearing	5, 9	3-33, 5-36
9AGE	1C883	Clamp—Turbine rotor to turbine frame	44, 45, 47	3-19, 6-3, 6-34
7800 805648	1C891	Nose fairing—Engine test	32	7-1
8220 621190	1C896	Sling—Turbine frame lifting	38, 40	3-13, 6-4
9AGE	1C899	Pliers—Snap-ring	3, 19, 24	2-9
9AGE	1C906	Jackscrew—No. 1 bearing oil seal	9	2-10
9AGE	1C973	Protector—Turbine rotor tie-bolt thread	46	2-11
8220 026670	1C980	Lift—Turbine rotor	21, 42, 43, 44, 45, 46, 47	3-11, 5-80, 6-2, 6-33
8220 014650	1C981	Eye—Engine lifting	21, 27, 28, 30, 31	3-1, 6-51
8220 633140	1C982	Stand—Turbine rotor assembly, (horizontal)	43, 44, 45, 46, 47, 48, 49	3-15, 3-20, 6-1, 6-32

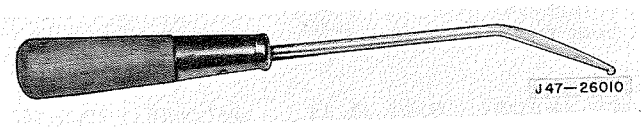


Figure 2–20. Cross Ignition Clamp Disassembly Hook, 1C2226

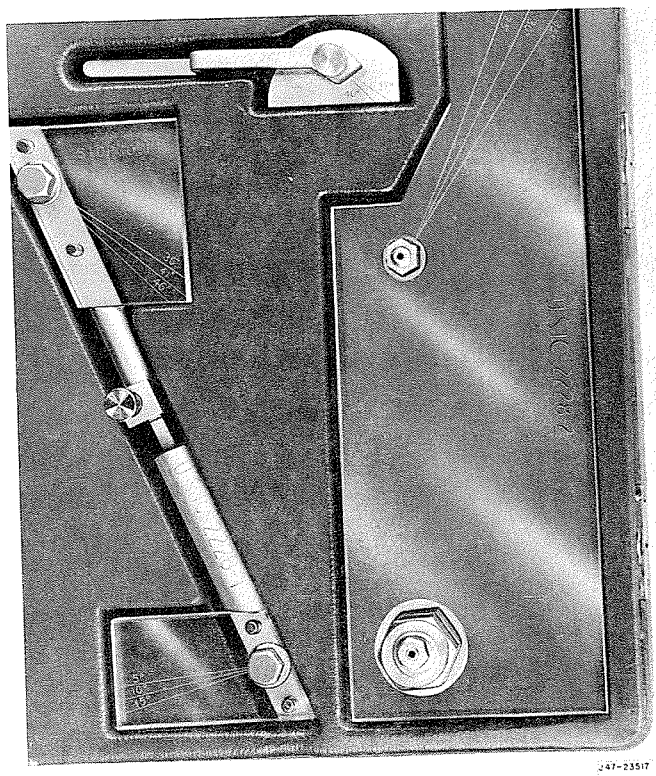


Figure 2–21. Adjustable Linkage Assembly Gage Set, 1C2228

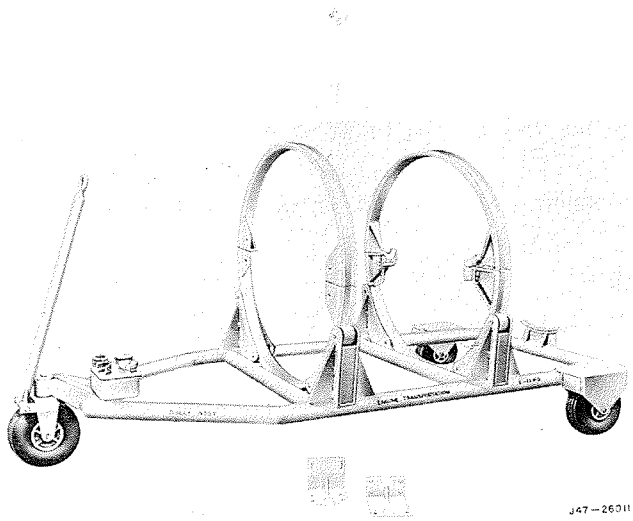


Figure 2–22. Engine Transportation Dolly M–2

TABLE IV. NUMERICAL TOOL LIST (cont)

USAF Stock No. Class Code	Tool No.	Nomenclature	Group No.	Figure No.
8220 026685	1C983	Lift—Turbine rotor	48, 49	2–12
9AGE	1C985	Adapter—Turbine tie-bolt torquing	38	6–9
9AGE	1C986	Puller—No. 3 and 4 bearing inner race hydraulic	43	3–44
8220 020475	1C987	Lift—Turbine rotor vertical	48, 49	6–54
9AGE	1C988	Clamp—Combustion chamber bellows compressing	4, 40, 41	3–9, 3–17, 6–12, 6–43
9AGE	1C989	Clamp—Combustion chamber bellows expanding	4	6–13, 6–44
7CGE	1C1617	Adapter—Nose fairing	32	2–13
7CGE	1C1633	Thermocouple and Harness Assembly—Bellmouth	32	7–10
7CGE	1C1640	Dolly—Engine test	30, 31	2–14
9CGE	1C1707	Aspirator, Aft Frame Vent	32	7–18
9CGE	1C1749	Test Set—Turbine Frame	32	7–16A
2000 740086–3	1C2014	Protector—Aft bearing air and oil seal	37, 46	2–15
8220 024794	1C2025	Sling—Stator casing vertical & horizontal	11, 18	3–28, 6–21
9AGE	1C2027	Pilot—Compressor rotor to front frame vertical	6, 10	3–21, 6–28
9AGE	1C2028	Guide—Compressor rotor pilot to front frame vertical	6, 10	3–21, 6–28
9AGE	1C2030	Stand—Engine assembly and disassembly, vertical	8, 21, 33, 34	3–7, 6–16, 6–29, 6–46, 6–47
8220 006860	1C2033	Sling—Turbine frame and turbine wheel, vertical	39, 45, 47	3–18, 6–36, 6–39
9AGE	1C2035–2	Spreader Bar—Compressor stator casing removal	6	6–29
9AGE	1C2035–3	Platform—Compressor stator casing removal	6	6–29
9AGE	1C2036	Adapter—Turbine tie-bolt torquing, vertical	7, 21, 38, 39, 46	3–10, 3–16, 6–8, 6–40
8220 014595	1C2037	Bracket—Engine assembly, horizontal to vertical lifting	6, 10, 21, 33, 34	3–7, 3–22, 6–27, 6–46, 6–47
9AGE	1C2039	Driver—Turbine wheel tie-bolt, assembly and disassembly	21, 38, 39, 46	3–10, 6–8, 6–40
9AGE	1C2040	Guide—Turbine frame aligning, vertical	39	2–16
8220 609292–25	1C2043	Sling—Engine assembly, horizontal and vertical	6, 10, 21, 33, 34	3–7, 3–22, 6–27, 6–46 6–47
9AGE	1C2044	Adapter—Engine motoring	29	2–17
9AGE	1C2047	Pusher puller transfer tube	15, 16	
2000 800579–5	1C2053–1	Shield—Compressor air inlet	29	2–18
2000 800579–3	1C2053–2	Shield—Compressor air inlet	29	2–18

TABLE IV. NUMERICAL TOOL LIST (cont)

USAF Stock No. Class Code	Tool No.	Nomenclature	Group No.	Figure No.
9AGE	1C2153	Bracket—Vertical assembly stand	7, 8, 21, 33, 34	3–7, 6–16, 6–47
9AGE	1C2187	Support—Engine aft end steel	21, 34	3–7, 6–47
9AGE	1C2217	Spacer—Turbine tie-bolt	45, 47	2–19
9AGE	1C2226	Hook—Cross-ignition clamp disassembly	40, 41	2–20
9AGE	1C2227	Lever—Cross-ignition clamp assembly	4	6–13
9AGE	1C2228	Gage Set—Adjustable linkage assembly	35	2–21
9AGE	1C2276	Pusher puller lube inlet transfer tube	15, 16	
9AGE	1C2284	Fixture—Fuel control valve positioning	22	*
8220 778700	M–2	Dolly—Engine transportation	20, 21, 31, 33, 34	2–22, 3–6

*Illustration will be supplied in a later revision.

SECTION III
DISMANTLING AND DISASSEMBLY

3-1. GENERAL.

3-2. COVERAGE. Instructions in this section cover dismantling and disassembly operations within the scope of repair which may be performed with the special tools listed in Section II and other common tools. Steps necessary for separating the engine into its major components are presented, as are procedures for disassembling these major components into their parts. Dismantling is divided into 2 sections: horizontal dismantling of the hot section, which includes removal of the compressor stator casings and vertical dismantling. The horizontal method will be used when no known damage exists beyond the turbine section, and the vertical method will be used when damage beyond the turbine frame is known or suspected. Also covered is the method of using horizontal dismantling for the hot section and transfer to the vertical method when found necessary after removal of the hot section.

Note

During each stage of disassembly, examine all parts and assemblies for scoring or burning. Look for indications of work incorrectly performed during any previous repair. Report any such indications in accordance with current practices. For detailed inspection procedures, see Section IV.

3-3. PROCEDURES. Dismantling and disassembly procedures contained in this section should be adopted as normal repair practice. Alteration of order of operations is permitted, providing the procedures are consistent with standard engineering practices and will not lower the quality of the repaired engine.

Note

Disassembly should proceed only as far as required for repair or replacement.

3-4. CLEANLINESS. Efficient operation of the turbojet engine is dependent in large part upon cleanliness of various engine components. Parts and assemblies must be kept clean and free from corrosion or foreign matter. Strict attention must be paid to all instructions in subsequent paragraphs calling for special handling of engine components, wrapping of parts, and similar matters.

CAUTION

Bearings must be given special care to prevent corrosion. Do not touch bearings with bare fingers, or with any device which might transfer contamination. Wear clean rubber gloves at all times when handling bearings. Refer to paragraph 4-62, and to Specification MIL-P-197B for specific instructions for handling bearings.

a. Keep the entire working area, inspection benches and tools clean. Keep all components free of dust, dirt and grease. All bearings will be protected when removed. Cap openings in components with protective closures. Use polyethylene storage bags for small components, if necessary. Inspect parts under adequate light as this is necessary to truly evaluate damage. Tag each component to indicate repair or replacement. Inspect nuts, bolts, clamps, brackets and related hardware for defects and discard non-serviceable parts. Numerous parts can be visually examined for external defects, but others require the use of micrometers, dial indicators and various types of measuring instruments or gauges. These precision tools must be kept in closed boxes or plastic covers and be calibrated at regular intervals.

3-5. PRECAUTIONS. Turbojet engines are manufactured to close tolerances. Avoid damage to engine parts by careful use of various fixtures and special tools as described in this and later sections. In dismantling the engine, use care to make certain all loose lockwire, washers, and similar objects are removed.

CAUTION

Failure to observe this precaution will result in damage to engine during testing after repair.

When the instructions call for the taking of measurements during dismantling, record these measurements on suitable forms. Heavy parts and assemblies should always be lifted by a chain hoist with special lifting yokes and slings to insure personal safety and avoid the possibility of dropping parts. Jack and attaching screws, nuts and bolts should be tightened in small increments on opposite planes. When driving on any part of the engine, metal head hammers must never be used. Plastic, nylon, or rawhide hammer heads are less likely to damage the engine or its parts.

WARNING

If the engine has been operated on gasoline containing tetraethyl lead, watch for yellow deposits on combustion and turbine section parts. These deposits contain lead which, if inhaled into the lungs or absorbed by the mucus membranes of the mouth or nose, may result in lead poisoning. To prevent this, keep contaminated hands away from nose and mouth, be sure all open cuts or sores are covered, that the work area is well-ventilated and that contaminated parts are cleaned before re-work operations. Men handling contaminated parts shall wash hands thoroughly with soap and water before using tobacco or eating.

3–6. STANDARD MATERIALS NEEDED DURING REPAIR. The materials listed here are considered essential for the proper maintenance of engine parts and assemblies during repair.

Barrier material, greaseproof paper
JAN–B–121, Grade A, type I, Class I
Barrier material, greaseproof paper
JAN–B–121, Grade A, type II, Class I
Tape, acetate, waterproof, self-gummed
JAN–B–127, type III, or IV
Tape, self-gummed, paperback
JAN–B–127, type III, Class C
Compound, corrosion preventive
MIL–C–6529, type I on type III
Oil lubricating, jet engine
MIL–O–6081, Grade 1010

CAUTION

Do not use tape on machined surfaces or for covering the openings on tubing and hoses. Fuel, oil, or grease will loosen the adhesive from the cloth or paper backing of the tape and permit the backing to fall or be washed into openings and internal portions of the engine. It is difficult and sometimes impossible to remove the adhesive when it comes loose from the backing. Cover openings with greaseproof paper and use tape only to secure the paper in place.

3–7. REMOVAL OF LOCKWIRE. Where lockwire is used for securing purposes, it must be removed prior to disassembly. Dismantling and disassembly instructions will not include lockwire cutting and removing operations.

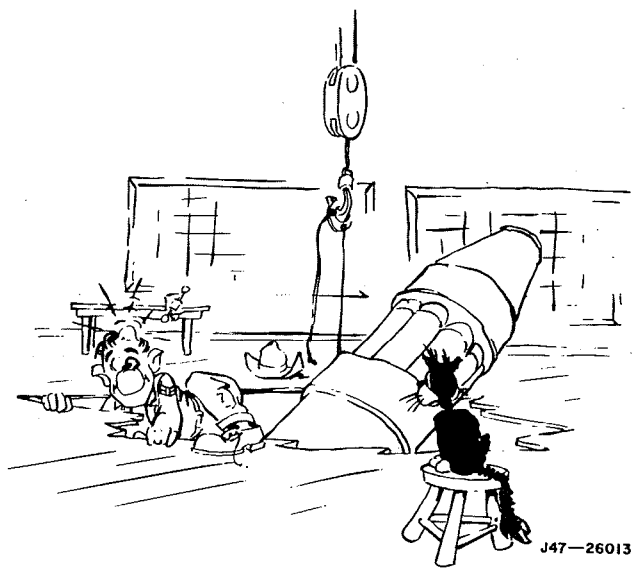
3–8. REMOVAL OF ENGINE PARTS. Place each engine part on a clean surface as it is removed from the engine. Tie groups of related parts together with string. Wrap small parts in greaseproof paper sealed with tape and tag or otherwise identify to prevent loss. This identification must include the engine serial number and component part number; if desired, a functional description may be added. If engine parts are to be stored for any length of time, the parts must be coated with a corrosion preventive compound.

3–9. CLASSIFICATION OF ENGINE PARTS. Dispose of unserviceable parts in accordance with current regulations. All re-usable parts of each engine should be kept together. The use of a properly identified parts truck or bin containing a suitable number of shelves or separate compartments is recommended. All special hose and tube assemblies should be tagged, upon removal from engine, with application, part number if available, and engine model. This will facilitate inspection and re-assembly.

3–10. USE OF TOOLS.

3–11. CLASSES OF TOOLS. Three classes of tools are used in dismantling the engine; common tools, special tools, and locally manufactured tools. Common tools are mentioned only when used in special applications. In each case where a special tool is required, it is identified by both name and group number. Refer to Section II for a list of special tools.

3–12. SPECIAL TOOLS. Special tools identified in this handbook are designed specifically for use on the subject engine. Use of makeshift tools should be avoided whenever possible.



CAUTION

Use of tools physically similar to those authorized may result in engine damage. Identification of tools by number is the only safe course to follow.

3–13. LOCALLY MANUFACTURED TOOLS. Locally manufactured tools will be called for only when special tools are not available at field level. The use of such tools will be held to a minimum to avoid the possibility of injury to personnel and damage to the engine.

3–14. PREPARATION FOR DISMANTLING.

3–15. REMOVAL FROM SHIPPING CONTAINERS.

3–16. REMOVING ENGINE FROM STORAGE AND SHIPPING CONTAINERS.

Note

For special tools see Section II, group 28. For specific information on shipping containers refer to Specification MIL–E–5607A.

a. Remove the valve core from the container and allow air pressure to bleed off. Remove all bolts and nuts from the horizontal flange of the shipping container. Install lifting sling and hoist and remove shipping container cover.

CAUTION

The 5 psig air pressure within the shipping container must be released prior to removing any of the cover bolts or gaining access to the dessicant.

b. Install lifting eye 1C981 on the top mounting pad of the compressor rear frame. (See figure 3–1.) Adjust the lifting eye clevis in the proper hole to balance the engine when lifting.

c. Remove all nuts and bolts securing the engine to the shipping container.

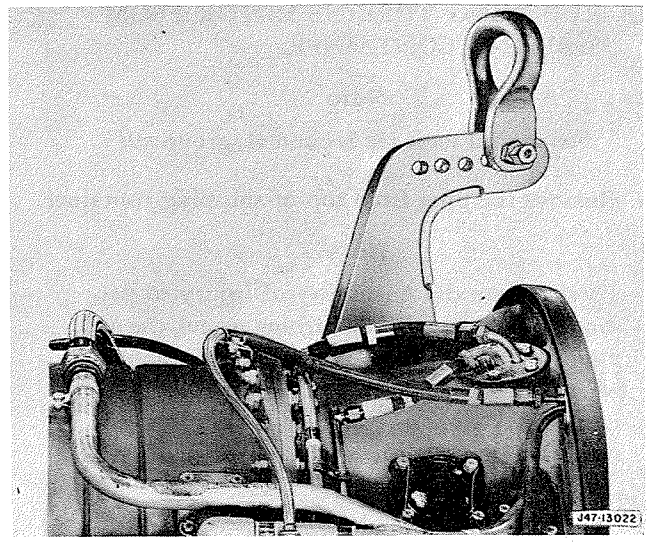


Figure 3–1. Engine Lifting Eye 1C981 Installed

d. Attach a lifting crane or hoist of at least 4000 pound capacity to lifting eye 1C981 and remove the engine from the shipping container.

e. Remove all shipping container mounting brackets and supports from the engine.

f. Remove the bolts and locknuts securing the turbine wheel brace to the turbine casing.

g. Remove the yellow support collar from the turbine wheel.

3–17. DELETED.

Figure 3–2. Deleted

3–18. REMOVING TURBINE ROTOR FROM SHIPPING CONTAINER.

Note

For special tools see Section II, group 49.

a. Remove the plug from top of shipping container.

Note

To eliminate the possibility of injury to personnel or damage to the turbine wheel, the air plug on the shipping container cover should be removed prior to removing the bolts. This is necessary since air pressure is used to check the container for leakage.

b. Cut the safety wire and remove the 4 bolts which secure the lid to the container.

c. Attach an overhead hoist to the lifting eye on the lid. Remove the lid. (See figure 3–5.)

CAUTION

To prevent the lid from damaging the rotor, lift it straight up.

d. Remove the rubber rings which protect the turbine rotor pilot.

e. Remove the paper from the rotor shaft.

f. Install lift 1C987 to the splined end of the turbine rotor shaft.

Figure 3–3. Deleted

Figure 3–4. Deleted

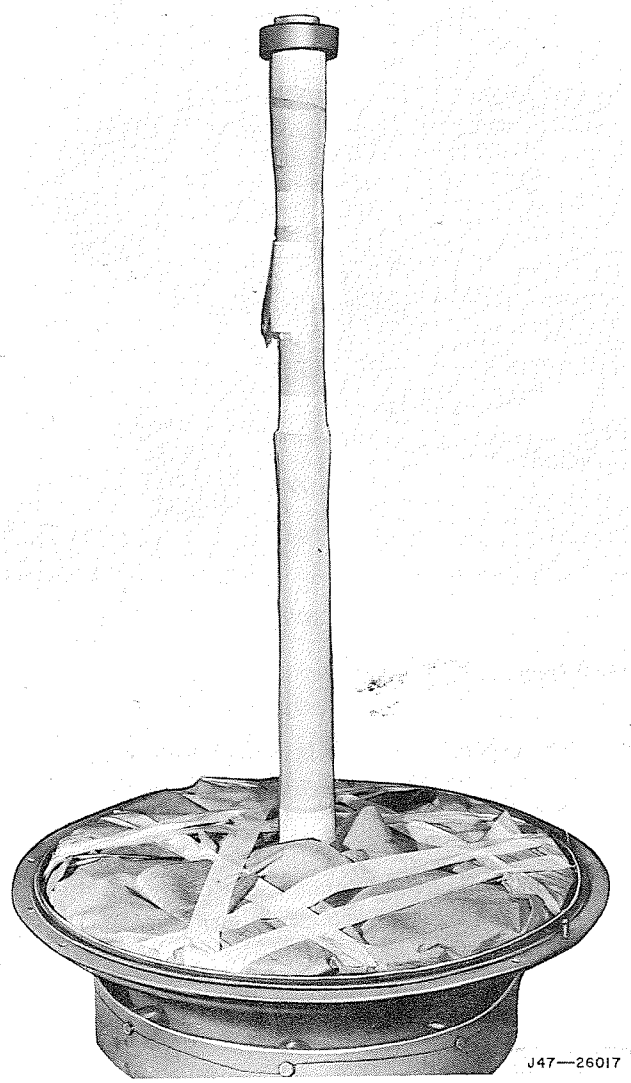


Figure 3–5. Turbine Rotor Installed in Shipping Container

g. Attach an overhead hoist to the lifting eye on the lift, and remove the turbine rotor from the shipping container.

h. Install lift 1C983 to the turbine shaft in front of the No. 4 bearing journal.

i. Attach a second overhead hoist to lift 1C983, and transfer the rotor from vertical to horizontal position by raising the hoist which is attached to lift 1C983 and lowering the hoist which is attached to adapter 1C987.

j. With turbine rotor in horizontal position, remove adapter 1C987 and the hoist.

k. Install turbine rotor in stand 1C982. Remove lift 1C983.

3–19. ENGINE INSTALLATION INTO REPAIR STAND.

3–20. INSTALLING ENGINE INTO M–2 TRANSPORTATION STAND.

a. With the engine suspended from a lifting hoist, install front frame bracket 1C619–59 to each side mounting pad of compressor front frame.

b. Install one mounting adapter to each side of compressor rear frame.

c. Secure the engine in the transportation stand at the front and rear brackets.

d. Remove the lifting adapter. (See figure 3–6.)

3–21. INSTALLING ENGINE INTO VERTICAL ASSEMBLY STAND.

Note

For special tools see Section II, group 21.

a. With the engine still suspended from the lifting hoist after removal from the shipping container or airframe, install one front frame bracket 1C619–59 (2, figure 3–7) to each side mounting pad of the compressor front frame with the mounting surface of the bracket forward.

b. Install one lifting bracket 1C2037 (3, figure 3–7) to each side mounting pad of the compressor rear frame.

c. Move the vertical disassembly stand 1C2030 (1, figure 3–7) into position. With the engine in the horizontal position, secure it to the vertical stand by attaching the front frame brackets to the stand.

d. Place engine auxiliary support 1C2187 (5, figure 3–7) under the turbine casing forward flange, and lower the engine onto the support stand.

e. Remove the lifting eye used to remove engine from shipping container.

f. Install lifting sling 1C2043 (4) to overhead hoist and attach to lifting brackets 1C2037 on the side mounting pads of the compressor rear frame.

g. Install bracket 1C2153 (6) to the top mounting pad of the compressor front frame.

3–22. DISMANTLING FOR PRELIMINARY INSPECTION.

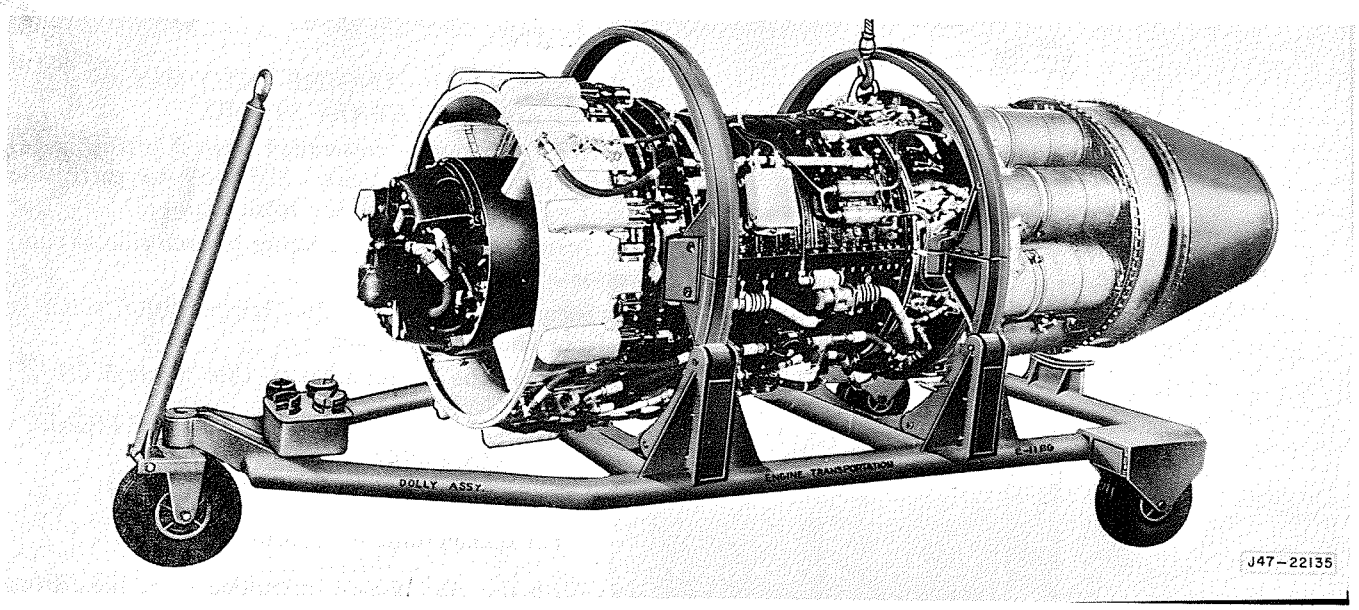
3–23. REMOVAL OF COMPONENTS FOR INSPECTION.

Note

For special tools see Section II, group 19.

a. Remove the covers of the regulator filter and orifice, high pressure fuel filter, and main lube filter. Inspect them for foreign particles.

b. Remove the lube drain sump plug from the opening in the bottom mounting pad of the compressor rear frame and the magnetic drain plug from the bottom of front frame gear case. Inspect the drained oil and the magnetic drain plug for foreign particles.



1. Bracket 1C619–59
2. Stand M–2

Figure 3–6. Engine Installed in M–2 Transportation Stand

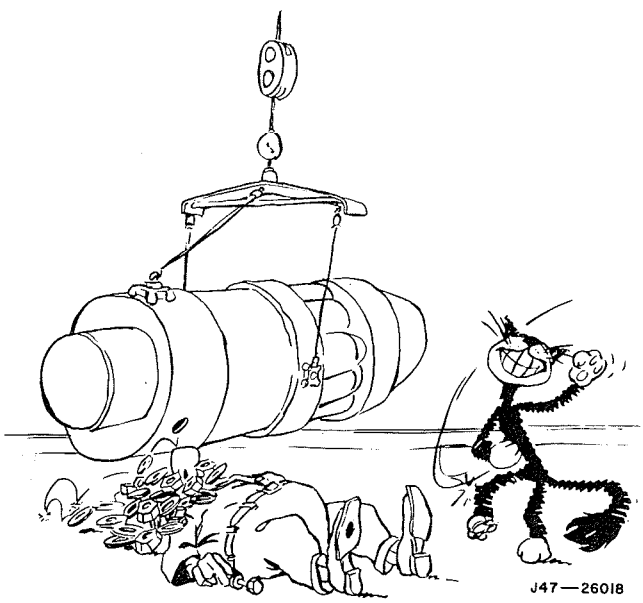
c. Raise the engine to a slight nose-down position and drain the oil from the turbine frame.

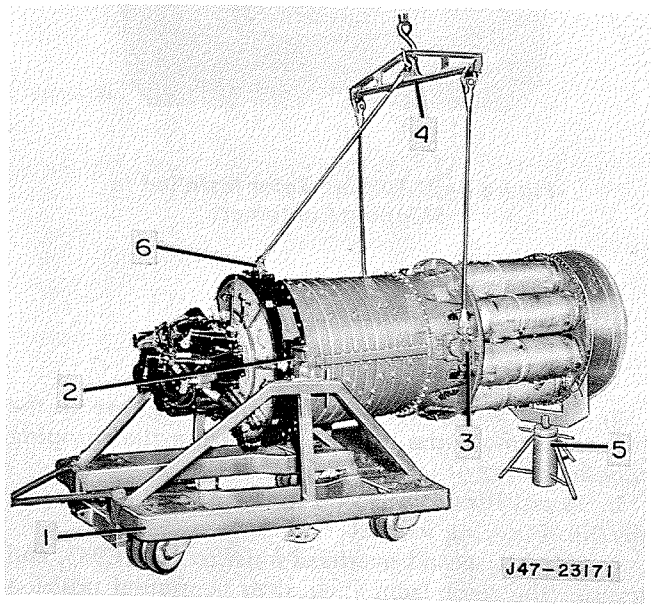
d. Open air inlet screens, if applicable, by supplying 24 volt d-c current to actuator motor, or by disconnecting the actuator flex shaft at actuator motor and cracking the screens open manually with locally manufactured adapter.

Note

The inlet guide vane and first 3 stages of rotor and stator blades should be visually inspected for possible damage. Refer to paragraph 4–103 for inspection limits. If removal of compressor stator casings is required for further inspection, refer to paragraph 3–33 of horizontal dismantling.

e. Remove 4 anti-icing connector elbows at the front end of each island cover assembly.





1. Stand 1C2030
2. Bracket 1C619–59
3. Bracket 1C2037
4. Sling 1C2043
5. Auxiliary Support 1C2187
6. Bracket 1C2153

Figure 3–7. Engine Installed in Vertical Disassembly Stand in Horizontal Position

f. Remove the 4 inlet island fairing assemblies by turning camlock fasteners on each side of fairing.

3–24. REMOVING AUXILIARY DRIVE GEARCASE.

Note

For special tools see Section II, group 3.

a. Disconnect the regulator filter and orifice by removing the bolts securing the bracket to the mount assembly.

b. Disconnect the main fuel filter by removing the bolts securing it to the bracket. Remove the bracket by removing the bolts securing it to the mount assembly.

c. Remove the clamp securing the bulletnose anti-icing line to the mount assembly.

e. Disconnect the lube-out line (scavenge line) from the alternator mount at the 6 o'clock position on the J47–25 and –25A engines, or the lube-in line (supply) to the hydraulic pump mount on the J47–27 engine.

f. Remove the mount assembly by removing the 9 lockrings and recessed Allen head screws from the outside periphery of the mount assembly on J47–25, –25A or –27 engine, or by removing the 6 lockrings and recessed Allen head screws from the mount assembly on the J47–23 engine.

Note

Reach in behind the mount assembly and disconnect the scavenge pump outlet hose on the J47–27 engine or the lube supply hose on the J47–25 and –25A engines.

CAUTION

Do not allow the auxiliary drive shaft to fall when removing the auxiliary gearcase. The splines on the drive shaft may be damaged if they strike any hard surface.

g. Remove the auxiliary drive shaft from the housing.

h. Remove the auxiliary cowl assembly by removing 8 lockrings and recessed Allen head screws.

i. Remove the auxiliary drive shaft housing from the compressor front frame by removing the snapring in the accessory cap assembly using snapring pliers 1C899 (figure 2–9) or standard No. 3 snapring pliers bent to 90 degree angle. On engines supplied with a mount pad, remove the snapring and coverplate.

j. Remove the auxiliary drive coupling by removing the securing snapring using snapring pliers 1C899 or standard snapring pliers No. 3. Remove the coupling using puller 1C785. (See figure 3–8.)

k. Remove the accessory drive inner coupling (figure 3–8) by removing the snapring using snapring pliers 1C899 and remove the inner coupling using puller 1C785.

l. Install pilot 1C2027 into the front end of the compressor rotor shaft by sliding the pilot through the accessory drive front bearing cap. Screw the pilot finger-tight into the shaft.

3–25. HORIZONTAL DISMANTLING.

3–26. REMOVAL OF EXHAUST CONE.

3–27. REMOVING EXHAUST CONE FROM ENGINE.

a. Disconnect the turbine rotor cooling air tube at the adapter on the exhaust cone.

b. If the thermocouple harness is installed, disconnect the clamp at the exhaust cone bracket.

c. Remove the exhaust cone insulator blanket.

d. If tailpipe is installed, disconnect the thermocouple leads at the electrical connector.

e. Remove the tailpipe clamp by backing off on both bolts until the clamp is loose. Then completely disengage one bolt and spread clamp.

Note

Support the tailpipe during this procedure to prevent it from falling or twisting.

f. Remove all but one bolt and nut at the 12 o'clock position from the exhaust cone flange.

g. With the exhaust cone supported, remove the remaining bolt and pull the exhaust cone away from the turbine casing, taking care to prevent the exhaust cone from falling on the turbine shroud ring.

Note

If the turbine shroud ring cannot be removed by hand, use a screw driver to pry in the provided cutouts on the forward flange.

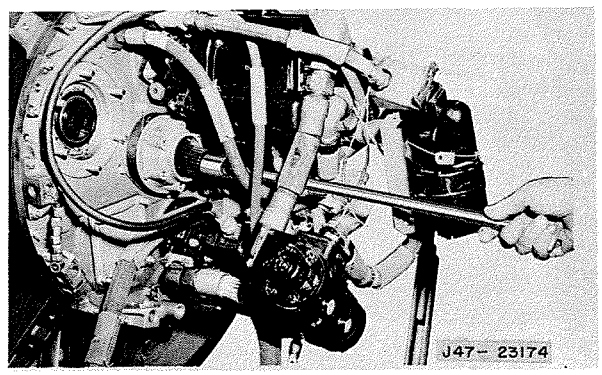


Figure 3–8. Removing Accessory Drive Inner Coupling Using Puller 1C785

3–28. REMOVAL OF COMBUSTION SECTION.

3–29. REMOVING COMBUSTION CHAMBERS.

Note

For special tools see Section II, group 40.

a. Remove all large and small slot flex lines between the fuel manifold and the fuel nozzles.

b. Remove the ignitor leads from the ignitor plugs in combustion chambers No. 3 and 7. Remove the ignitor plugs and the retainers which secure the ignitor leads to the firewall. Pull the leads through the firewall.

c. Remove the thermocouple lead insulator from the firewall. Pull the lead through the firewall.

d. Remove the lockwire and the 8 bolts from each fuel nozzle on the compressor rear frame. Remove the fuel nozzles and gaskets.

e. Remove all accessible drain lines from the combustion chamber drain manifold. This manifold is located between combustion chambers No. 4 and 5.

f. Remove the twelfth-stage cooling air tube at the compressor rear frame. Wrench 1C723 (figure 2–6) will be useful in this operation.

g. On engines equipped with water-alcohol injection system, remove the manifold by removing the tubes, clamps, check valve, connector tee and connecting bolts.

h. On engines with the elliptical type cross-ignition system, remove the 8 Marmon clamps on cross-ignition tubes using hook 1C2226 (figure 2–20). On engines with the bellows type cross-ignition system, remove the bolts, cross-ignition tubes, gaskets, and inner connectors from the combustion chambers.

i. Remove the Marmon clamps from the forward and rear ends of combustion chambers using hook 1C2226 (figure 2–20).

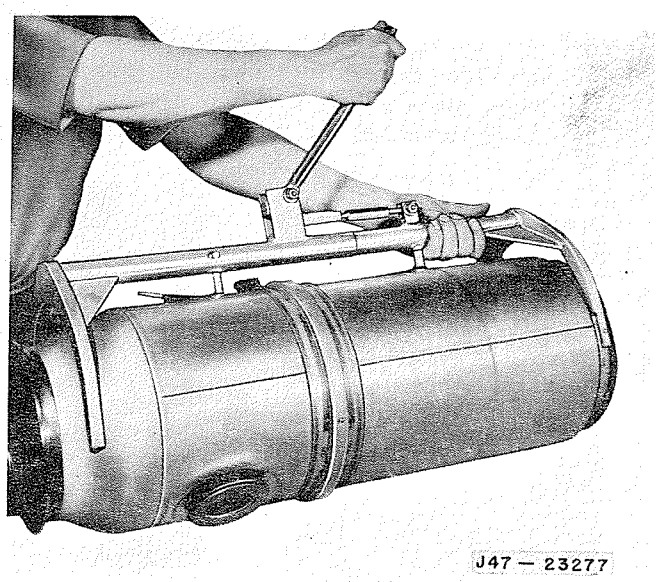
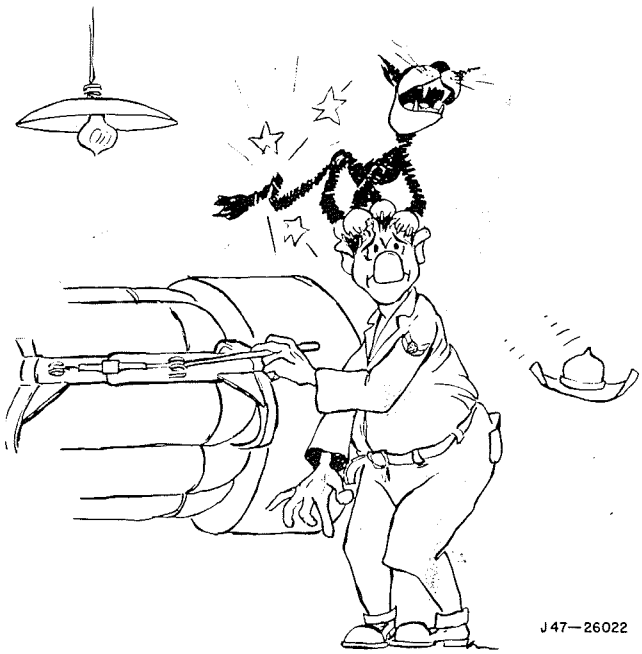


Figure 3–9. Removing Combustion Chambers Using Clamp 1C988

j. Compress and remove the combustion chambers using bellows compression tool 1C988. (See figure 3–9.) Remove chambers 4 and 5 first.

Note

On engines with bellows type cross-ignition system, the bolt securing the inner combustion chamber to the outer combustion chamber must be removed before compression so the inner chamber can be moved forward. This allows the inner chamber to clear the transition liners.



CAUTION

Do not permit fingers or hands to be pinched between the compression tool and the combustion chamber. When using the compression tool on chambers 4 and 5, take care not to crack the combustion chamber at the drain fitting.

k. On engines with the elliptical type cross-ignition system, remove the front drain lines on chambers No. 3 and 6 before removing the combustion chambers. On engines with the bellow type cross-ignition system, there are no forward drain lines.

l. Remove the rear combustion chamber drains on chambers No. 2 and 7 on both combustion systems. On the bellows type cross-ignition system, remove the forward drain lines before removing the combustion chambers.

m. Remove the forward and rear drain lines from both types of cross-ignition systems on combustion chambers No. 1 and 8 before removing the combustion chambers.

n. Remove the 4 bolts and washers securing the forward drain manifold and the scavenge pump inlet tube and finger screen to the turbine frame.

3-30. REMOVAL OF TURBINE SECTION.

3-31. REMOVING TURBINE ROTOR FROM THE ENGINE.

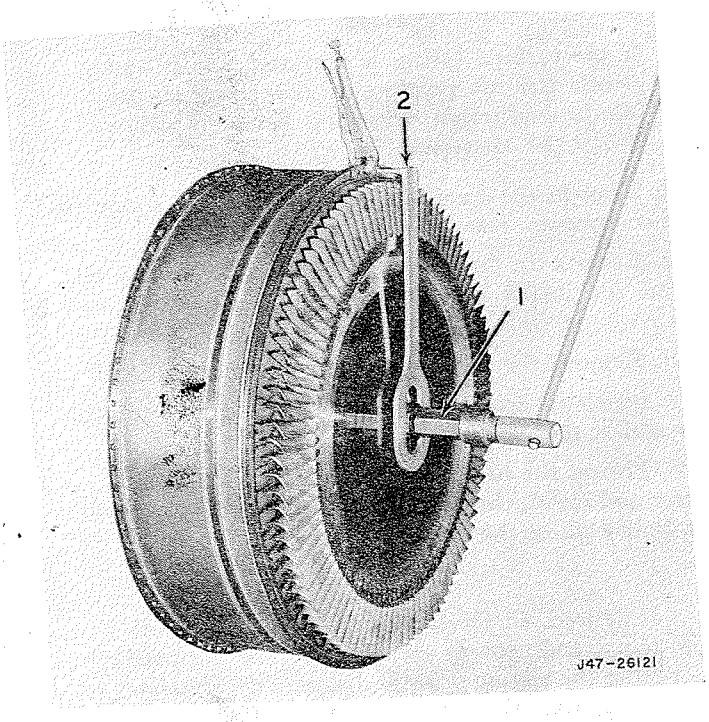
Note

For special tools see Section II, group 46.

a. Remove the cotter pin from turbine rotor tie-bolt nut.

b. Straighten the tabs on the turbine rotor tie-bolt tabwasher.

c. Install turbine rotor holding wrench 1C695 or 1C2036. (See figure 3-10.)



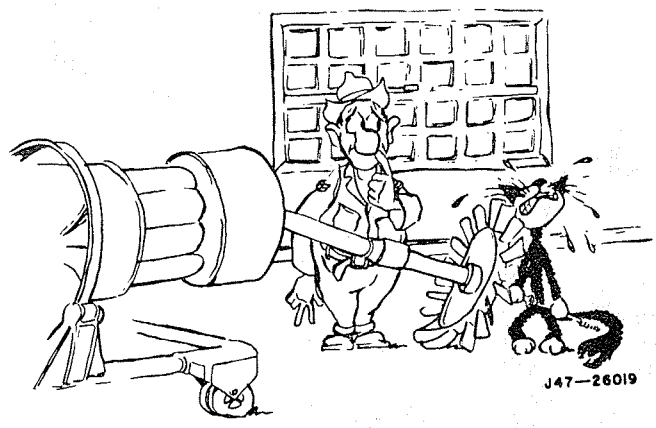
1. Driver 1C2039 2. Wrench 1C2036

Figure 3-10. Removing Tie Bolt

d. Remove the tie-bolt nut from the tie-bolt with a socket wrench and a long extension bar.

Note

If the tie-bolt breaks loose while the tie-bolt nut is being removed, thread the bolt out far enough to install wrench 3177 (figure 2-1) or a suitable substitute on the wrench flats of the bolt. Break the nut loose and thread the bolt back into compressor.



CAUTION

When threading the tie-bolt out to expose the wrench flats, take care to prevent the tie-bolt from pulling the turbine rotor free of the splines and allowing it to fall on the No. 4 bearing oil seal.

e. Install tie-bolt driver 1C2039 (1, figure 3-10) on the tie-bolt threads far enough to install a pin through the driver and into the cotter pin hole. Thread the bolt of the driver to the left until it engages the tie-bolt. Using a wrench on the left-hand-threaded bolt of the driver, continue in a left-hand direction until the tie-bolt breaks loose.

f. Remove the tie-bolt driver and the holding wrench.

g. Install the turbine rotor lift 1C980 (figure 3-11) on the turbine rotor hub and lift the turbine rotor enough to relieve the weight of the rotor from the bearings.

Note

In order to make certain too much pull is not applied to the lift, a lifting scale may be used between the hoist and the lift. A pull of 300 pounds is the maximum that should be applied.

h. Remove the turbine rotor from the turbine frame using the hydraulic jack on lift 1C980 to break the turbine shaft free of the compressor splines. Slide the turbine rotor out of the turbine frame.

CAUTION

Care should be taken to prevent damage to the No. 4 air and oil seal during removal of the turbine rotor. Do not jostle turbine rotor from side to side during removal.

Note

If desired, bearings can be removed while the turbine rotor is on lift 1C980. For procedure see paragraph 3-66.

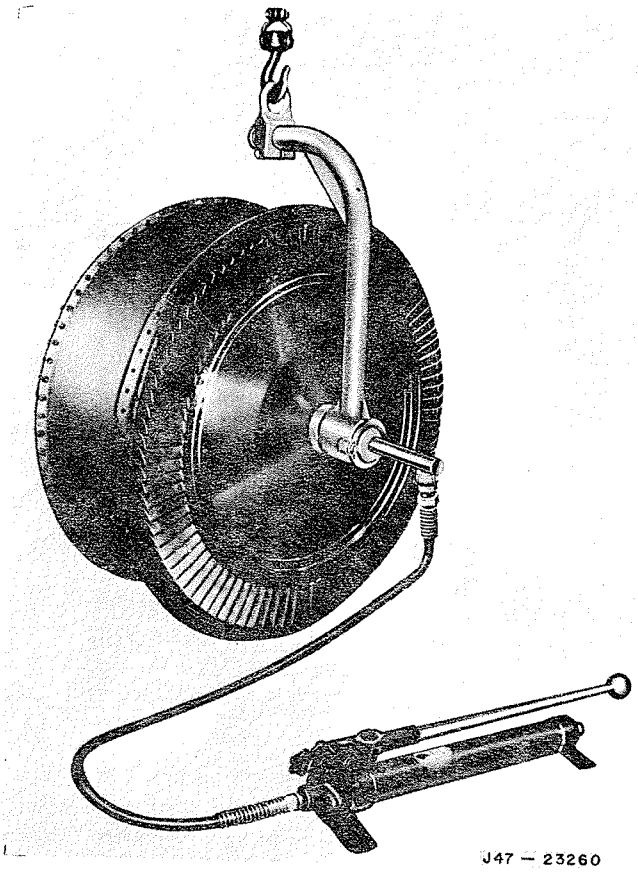


Figure 3–11. Turbine Rotor Lift 1C980 Installed

i. Install turbine rotor guard 1C606 (1, figure 3–12), No. 4 bearing protector 1C691 (2, figure 3–12) and No. 3 bearing protector 1C687 (3, figure 3–12) on the turbine rotor.

CAUTION

When installing guard on locking strip, turbine wheels, use extreme care to prevent bending or deforming the locking strip tabs. Replace locking strip if tabs are damaged; otherwise, failure may occur.

j. Install turbine rotor in transportation stand 1C982 (figure 3–13).

3–32. REMOVING TURBINE FRAME FROM ENGINE.

Note

For special tools see Section II, group 40.

a. Disconnect the oil drain flex tube at the scavenge pump.

b. Install protectors over the compressor rear frame burner ports and over the turbine frame burner ports.

c. Remove the scavenge pump and gasket from the compressor rear frame by removing the 3 retaining bolts. Remove the compressor rear frame-to-scavenge pump coupling.

d. Disconnect the eighth stage cooling air bellows at the compressor rear frame.

e. Install turbine frame lifting sling, 1C896 (figure 3–14) to the turbine frame; attach an overhead hoist to the sling and take up the slack.

Note

If the turbine casing is removed, adjust and attach the aft portion of the sling to the nozzle diaphragm mounting flange in order to lift the aft frame.

f. Remove the nuts securing the turbine frame to the compressor rear frame.

g. Remove the turbine frame from the compressor rear frame and install it in turbine frame stand 1C632 in a horizontal position. (See figure 3-15.)

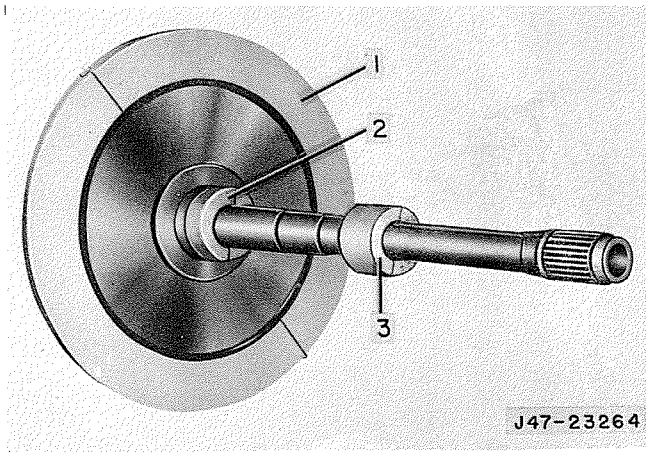
h. Remove the turbine frame lifting sling 1C896.

i. Install air seal shield 1C2014 (figure 2–15) on the air seal at the No. 4 bearing.

j. Thread the turbine tie-bolt out of the compressor rotor and install thread protectors 1C973 (figures 2–11) on both ends of the tie-bolt.

Note

If desired, all accessories, fuel, electrical, anti-icing, and cooling air lines may be removed from the engine prior to disassembly of major assemblies. Otherwise the engine may be disassembled as follows and the lines and accessories removed from the units in disassembly areas as required.



1. Guard 1C606
2. Protector 1C691
3. Protector 1C687

Figure 3–12. Bearing Protectors and Turbine Bucket Protector Installed

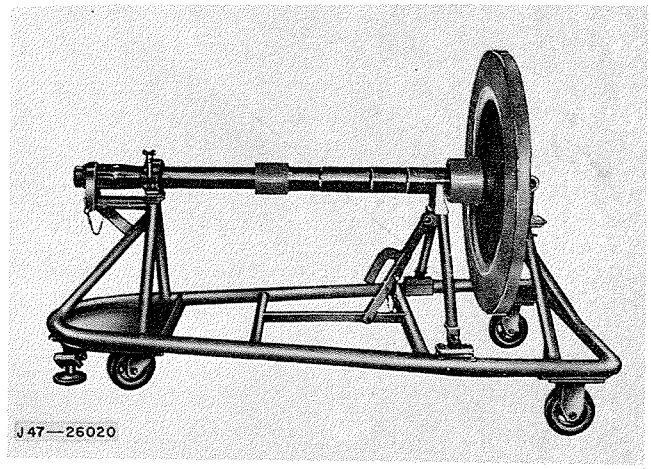


Figure 3–13. Turbine Rotor Installed in Stand 1C982

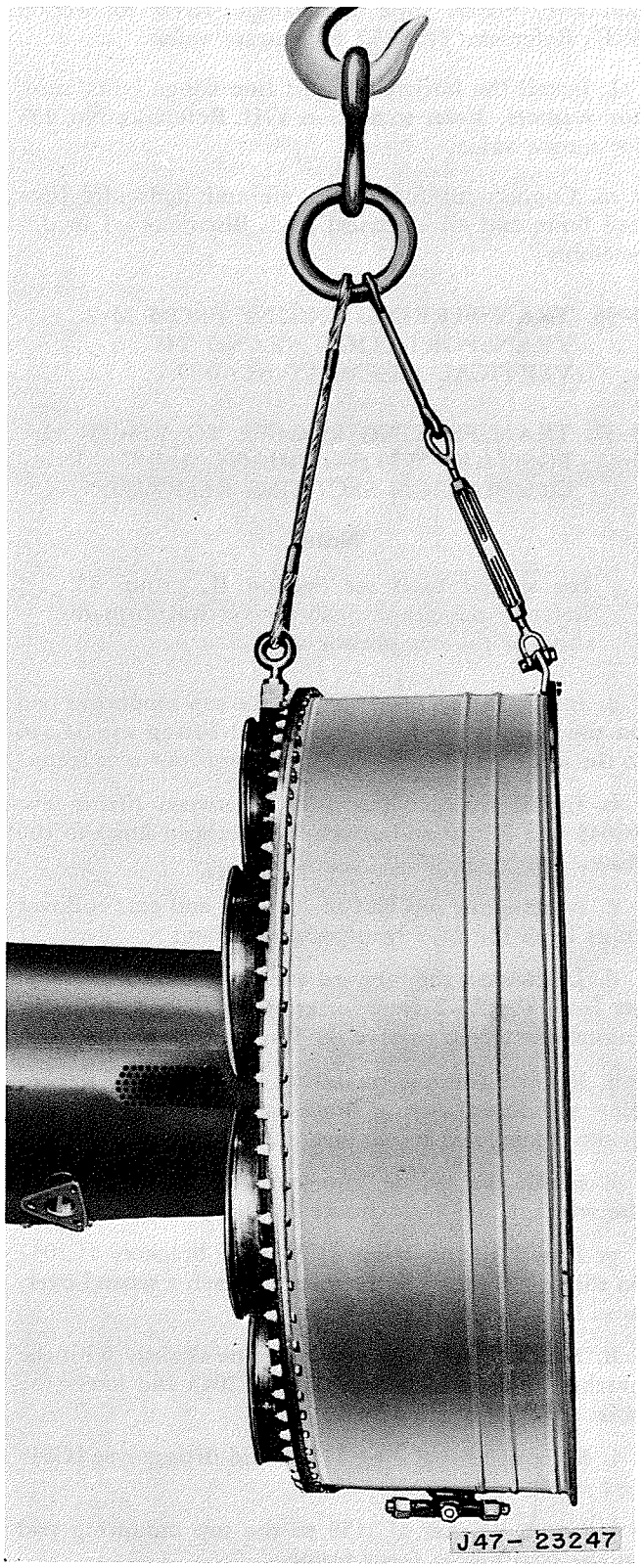


Figure 3-14. Sling 1C896 Installed on Turbine Frame

3-33. REMOVAL OF COMPRESSOR STATOR CASINGS.

3-34. REMOVING UPPER STATOR CASING.

a. Disconnect all fuel, lube, air, and hydraulic hoses and lines and all electrical leads between the compressor front frame and the upper stator casing.

b. Disconnect all fuel, lube, air, and hydraulic hoses and lines and electrical leads between the compressor rear frame and the upper stator casing.

c. Remove all bolts, nuts, and washers from the horizontal split line flange.

d. Remove all bolts, nuts, and washers from the vertical split line flange on the compressor front frame and the compressor rear frame that secures the upper stator casing.

e. Disconnect all fuel, lube, air and hydraulic hoses and lines and all electrical leads between the upper and lower stator casings.

f. Install 2 eye bolts to the mounting bosses on the stator casing at the forward and rear 12 o'clock position.

g. Install a locally-manufactured lifting sling between the 2 eye bolts and attach an overhead hoist to the sling.

h. Lift the compressor casing from the engine, taking care not to strike any compressor blades.

i. Inspect for damaged blades in accordance with Section IV, paragraph 4-107.

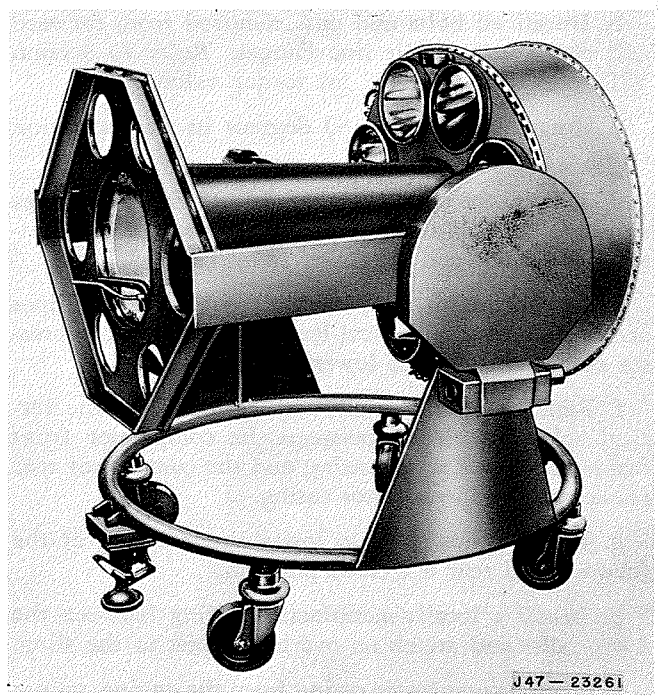
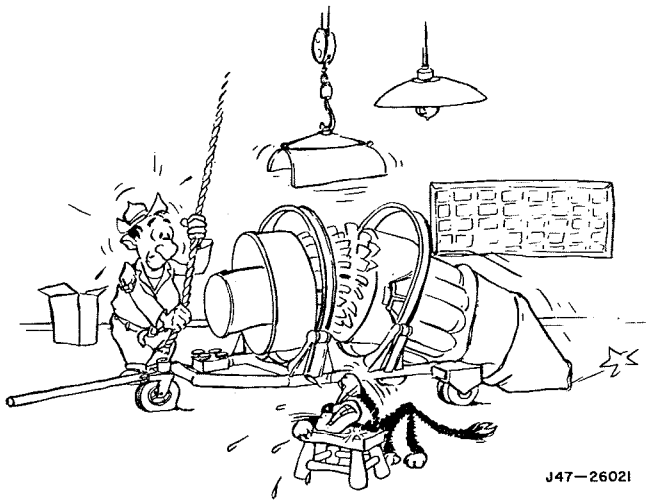


Figure 3-15. Turbine Frame Installed in Stand 1C632

3–35. REMOVING LOWER STATOR CASING.



CAUTION

If damage found on removal of the upper compressor stator casing warrants removal of the lower stator casing, re-install the upper stator casing before removing the lower stator casing.

a. Carefully lower the upper stator casing back onto the compressor rotor.

b. Install all bolts and nuts removed from forward and rear vertical split line flanges. Refer to Section VIII, Reference No. 152 for torque value.

c. Rotate the engine 180 degrees in transportation stand.

d. Disconnect all fuel, lube, air and hydraulic lines and hoses and all electrical leads between the compressor front frame and the lower stator casing.

e. Disconnect all fuel, lube, air and hydraulic lines and hoses and all electrical leads between the compressor rear frame and the lower stator casing.

f. Remove all bolts, nuts, and washers from the vertical split line flange between the compressor front frame and lower stator casing and the compressor rear frame and the lower stator casing.

g. Install 2 eye bolts to lower stator casing at the forward and rear 6 o'clock position.

h. Install a locally-manufactured sling between the 2 eye bolts and attach an overhead hoist to the sling.

i. Lift the compressor casing from the engine, taking care not to strike any compressor blades.

j. Inspect for damaged blades in accordance with Section IV, paragraph 4–107.

k. After inspection, re-install the lower stator casing and install all bolts, nuts, and washers in the forward and rear vertical split line flange. Refer to Section VIII, Reference No. 152 for torque value.

l. Install the horizontal split line flange bolts, nuts, and washers. Refer to Section VIII, Reference No. 153 for torque value.

m. Connect all fuel, lube, air and hydraulic lines and hoses and all electrical leads disconnected in disassembly.

3–36. TRANSFERRING ENGINE FROM M–2 TRANSPORTATION STAND TO VERTICAL ASSEMBLY STAND.

3–37. TRANSFERRING ENGINE TO VERTICAL POSITION WITH TURBINE AND COMBUSTION SECTIONS REMOVED.

Note

For special tools see Section II, group 33. Refer to paragraph 3–46 for vertical dismantling of the compressor section.

a. Install lifting eye 1C645 to the top mounting pad on the compressor front frame and lifting eye 1C646 to the top mounting pad on the compressor rear frame.

b. Install lifting sling 1C809 between lifting eye 1C645 and 1C646 and attach an overhead hoist to the sling.

c. Remove the top half of forward and rear rollover rings from the M–2 transportation stand.

d. Disconnect the forward and rear mounting brackets from the M–2 transportation stand and raise the engine enough to remove the stand.

e. Remove the rear mounting brackets from the engine and install lifting brackets 1C2037 to each side of the compressor rear frame.

f. Install the engine into stand 1C2030 and secure the stand to the front frame brackets 1C619–59.

g. Install lifting sling 1C2043 to brackets 1C2037 on the compressor rear frame and attach a second overhead hoist to sling 1C2043.

h. Raise the rear end of the engine slightly with the overhead hoist attached to sling 1C2043 and lower the hoist attached to sling 1C809.

i. Remove lifting sling 1C809 and lifting eyes 1C645 and 1C646.

j. Install bracket 1C2153 to the top mounting pad on the compressor front frame.

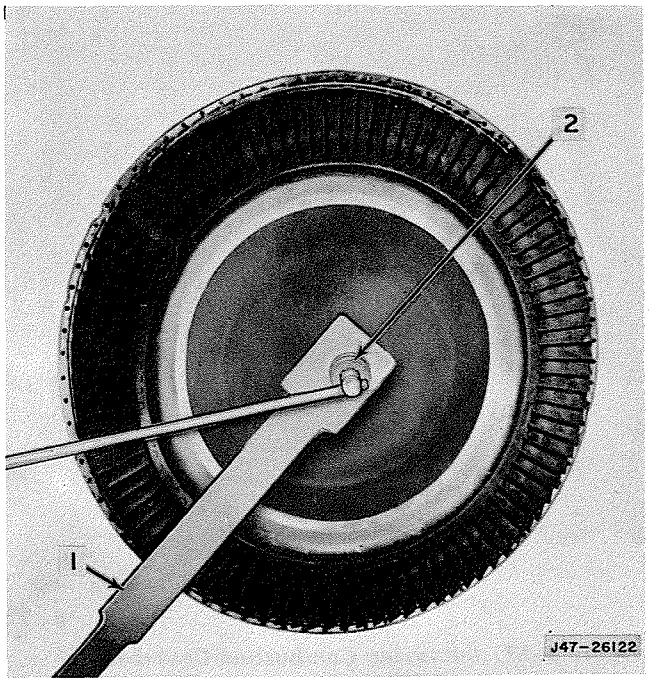
k. Raise the engine to a vertical position in stand 1C2030 and attach the forked arm of stand 1C2030 to bracket 1C2153.

3–38. DELETED.

3–39. DELETED.

3–40. DELETED.

3–41. DELETED.



1. Wrench 1C695
2. Driver 1C2039

Figure 3–16. Loosening Turbine Rotor Tie-Bolt

3–42. DELETED.

3–43. DELETED.

3–44. DELETED.

3–45. DELETED.

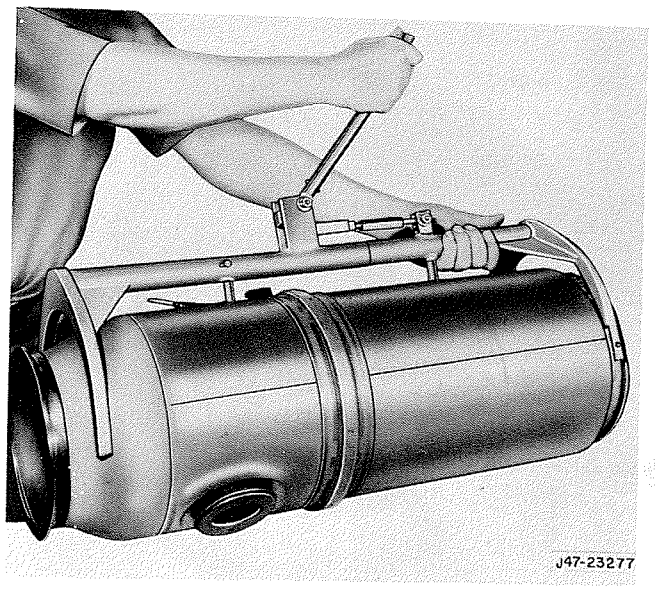


Figure 3–17. Removing Combustion Chambers with Clamp 1C988

3–46. REMOVAL OF COMPRESSOR FRONT FRAME.

Note

If the aft frame is or will be removed during required inspection/maintenance, the engine shall be transferred to the vertical position (with forward end up) to remove and install the front frame. This can be accomplished by setting the mid-frame on a wooden pallet or blocks, and by using special tools listed in paragraph 3–47 d. If aft frame removal is not required, the front frame may be replaced in the horizontal position. However, horizontal removal or installation shall not be accomplished under any circumstances unless the aft frame and turbine wheel are installed and both the turbine wheel tie-bolt and nut are properly torqued.

3–47. REMOVING COMPRESSOR FRONT FRAME FROM COMPRESSOR SECTION.

a. Disconnect all fuel, oil, and air hoses, tubes, electrical connections, and the throttle linkage between the compressor front frame and the stator casings.

b. Remove the nuts and bolts securing the air inlet sectors and islands to the front frame, and remove air inlet sectors and islands as a unit. The air inlet sectors, fillers, and islands need not be disassembled unless necessary to accomplish repair.

c. Remove the nuts and bolts securing the front frame to the stator casings. Install pilot, 1C2027. (Refer to paragraph 3–24.)

d. Attach 2 brackets, 1C619–59, and 2 lifting brackets, 1C810 (figure 3–23), to the front frame mounting pads. Locate brackets, 1C810, with lifting eye pointed forward. Attach sling, 1C808, to the lifting brackets and remove the front frame assembly.

Note

For disassembly of the front frame, i.e., removal of air inlet sectors, No. 1 air oil seal, inlet guide vane, etc., refer to paragraphs 3–51 through 3–58.

CAUTION

Do not intermix No. 1 bearing inner and outer races. Therefore, if the front frame and/or No. 1 bearing outer race and rollers are replaced, be sure to remove the No. 1 bearing inner race (using wrench, 1C783, and puller, 1C784, shown in figures 3–30 and 3–31), and install a matched inner race on the compressor rotor.

Figure 3–18. Deleted

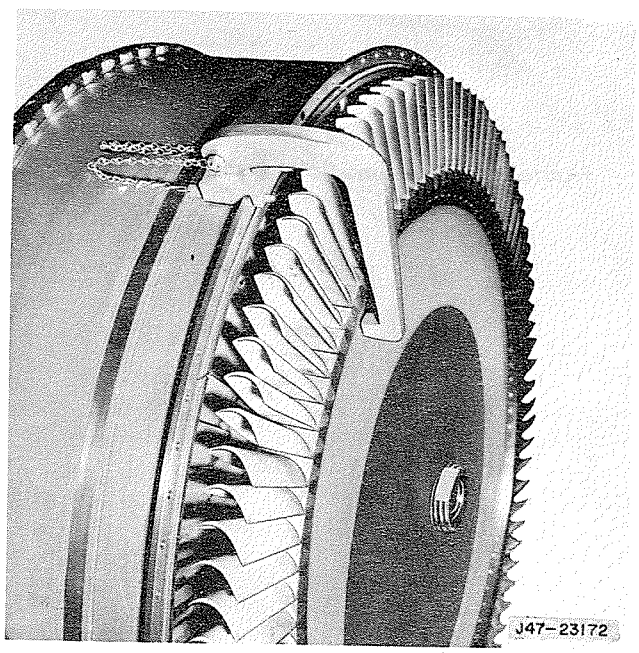


Figure 3–19. Holding Clamp 1C883 Installed on Turbine Rotor

e. Instructions for horizontal removal of the front frame are as follows:

WARNING

Vertical replacement shall be accomplished if the aft frame is or will be removed during periodic inspection or unscheduled maintenance. If horizontal replacement is accomplished, it will be necessary to use aluminum shims, locally fabricated (figure 3–24), between 17 first-stage rotor blade tips and the stator case to prevent rotor replacement during front frame removal and/or installation.

(1) Install shims between 8 rotor blade tips and the stator case at the 6 o'clock position, and 3 each at the 3, 9, and 12 o'clock positions. The shims must be tapered to ensure a tight fit. They should be installed from the aft side of the blades to prevent their being displaced during front frame removal and installation. (See figure 3–25.)

(2) Install a locally fabricated support on each side of the engine from the forward end of the stator case to the engine stand to hold the engine steady and prevent any movement. (See figure 3–26.)

(3) Remove the 2 front-frame-to-stator-case attaching bolts from each of the front frame mounting pads at the 3, 9, and 12 o'clock positions. Attach lifting pad, 1C645 (figure 2–2), to the front frame mounting pad at the 12 o'clock position.

(4) Locally fabricate 2 guides, or stabilizer bars, and attach them to the front frame mounting pads at the 3 and 9 o'clock positions.

Note

Guides can be made from pipe approximately one inch in diameter by 3 feet in length and 1/8-inch steel plate. Weld one end of the pipes to the steel plate so the other end will extend out forward of the engine.

(5) Disconnect all connections necessary between the front frame and stator casings as specified in subparagraph "a".

(6) Remove inner coupling and install pilot, 1C2027. (See paragraph 3–24 and figure 3–8.) Install lifting pad, 1C645 (figure 2–2), on the front frame mounting pad at the 12 o'clock position.

(7) Attach a hoist to the eye on lifting pad, 1C645; remove the remainder of nuts and bolts securing the front frame to the stator casings; and with personnel holding the front frame in alignment with the 2 guide bars, remove the front frame.

CAUTION

It is imperative that extreme care be used during removal to assure that the front frame is held in perfect alignment with the engine to prevent damage to the No. 1 bearing, air and oil seals, and mounting rabbet.

3–48. DELETED.

3–49. DELETED.

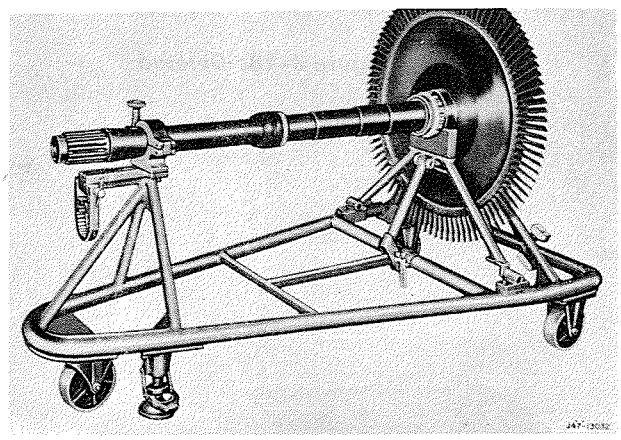
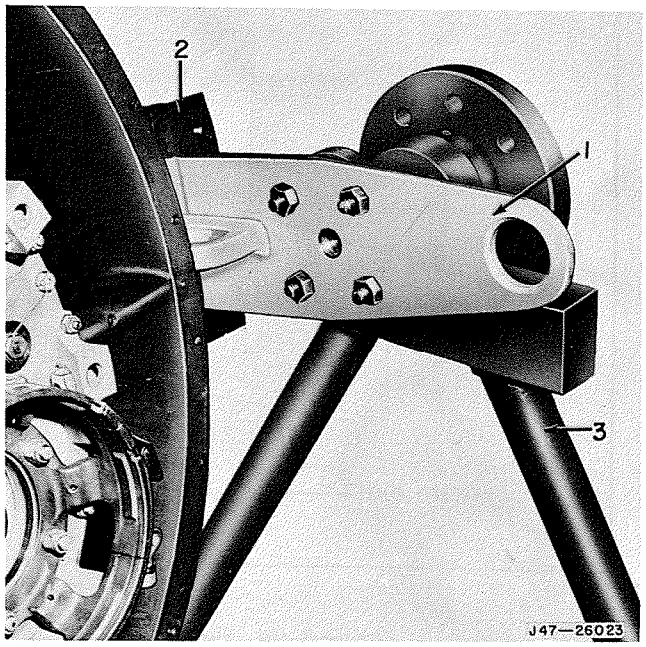


Figure 3–20. Turbine Rotor Installed in Stand 1C982

Figure 3–21. Deleted

Figure 3–22. Deleted



1. Bracket 1C810
2. Bracket 1C619–59
3. Stand 1C817

Figure 3–23. Compressor Front Frame Installed in Stand 1C817

3–50. DELETED.

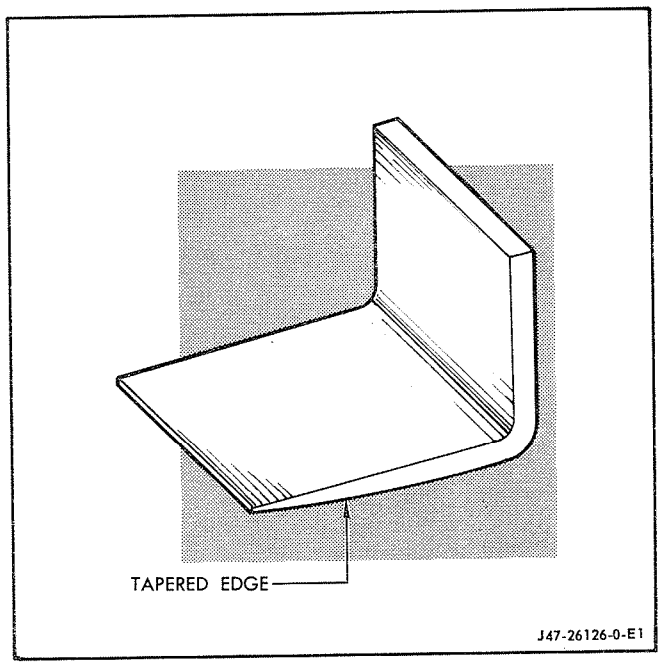


Figure 3–24. Shim

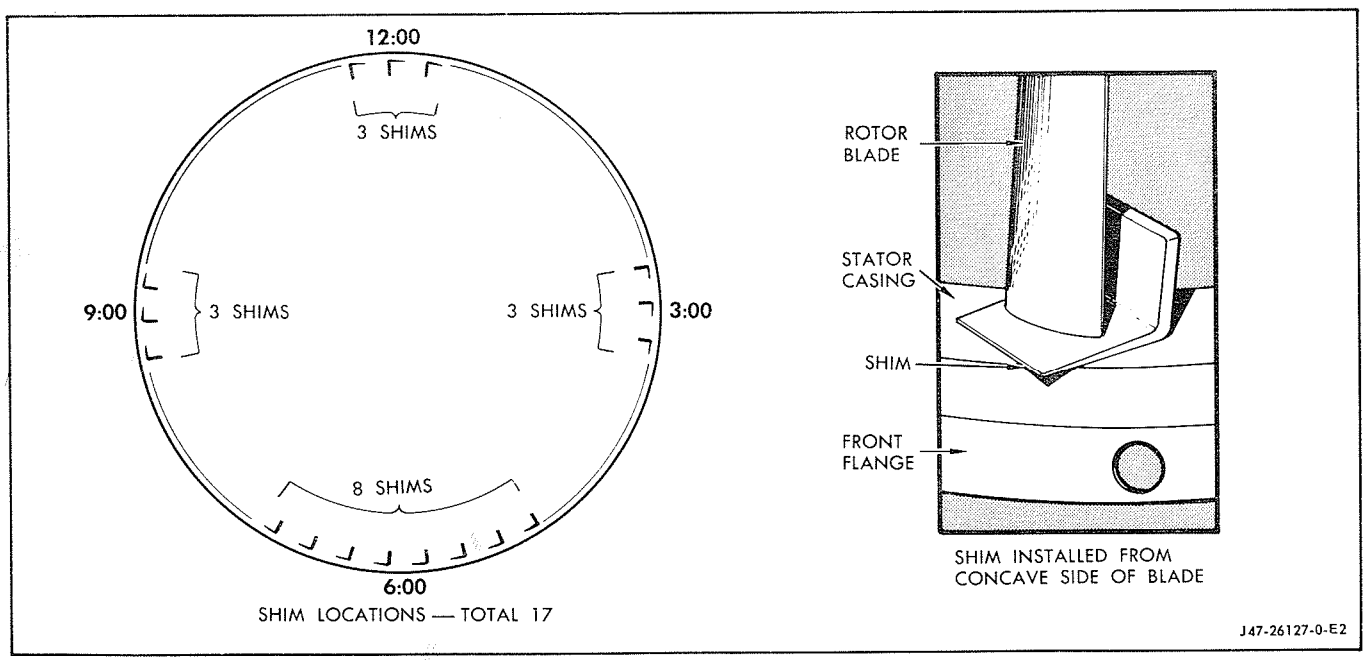


Figure 3–25. Installation of Shims Between Rotor Blade Tips and Stator Casing

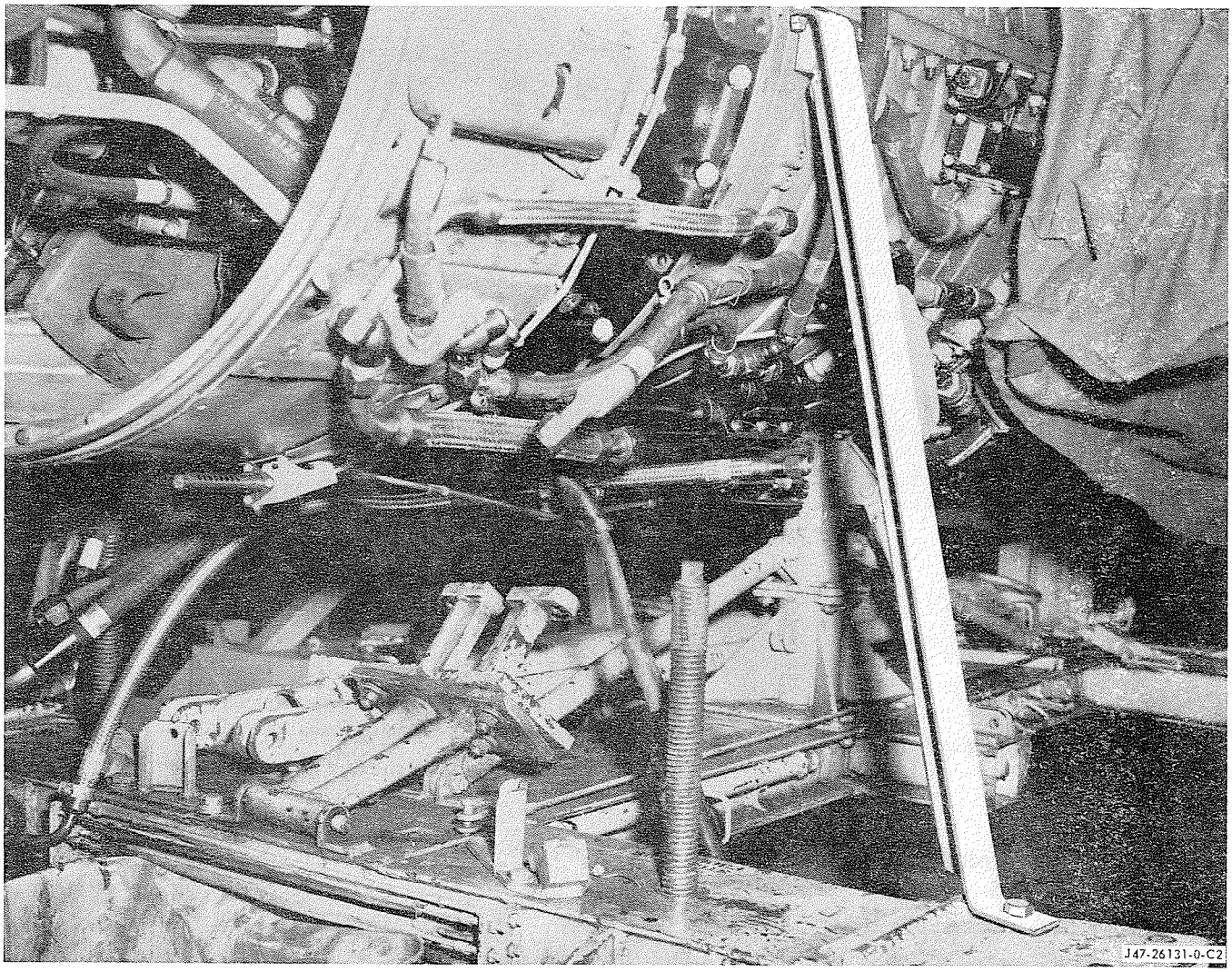


Figure 3–26. Support—Engine Stand to Stator Casing

3–51. DISASSEMBLY OF SUBASSEMBLIES.

3–52. COMPRESSOR FRONT FRAME.

3–53. REMOVING AIR INLET SECTORS AND SCREEN ACTUATORS.

a. Remove the 3 brackets which secure the air inlet screen flex drive shafts to the front frame.

b. Remove the actuator motor and 8 flex drive shafts by removing the bolts securing them to the front frame.

c. Disconnect the camlock fasteners that secure the air inlet sectors to the short island fairings and remove the fairing from islands No. 2, 3, and 4.

d. Remove sector assemblies by removing the bolts securing them to the front frame.

e. To disassemble the sector assemblies, remove the cowl guides from the sector assembly on J47–23, –25 and –25A engines by removing screws and bolts.

Note

Remove the accumulator from the cowl guide that was adjacent to the No. 3 island after removal of cowl guide. On some engines, air inlet screens are not installed.

f. Remove the outer actuator housing cover from the housing assembly.

g. Remove the jack screw from the screen actuator housing assembly.

h. Remove the baffles by removing the screws from the sector.

i. Remove the air inlet screens and bearings by removing the bearing securing bolts from the actuator housing.

j. Remove the actuator housings from the sector and replace cover on housing.

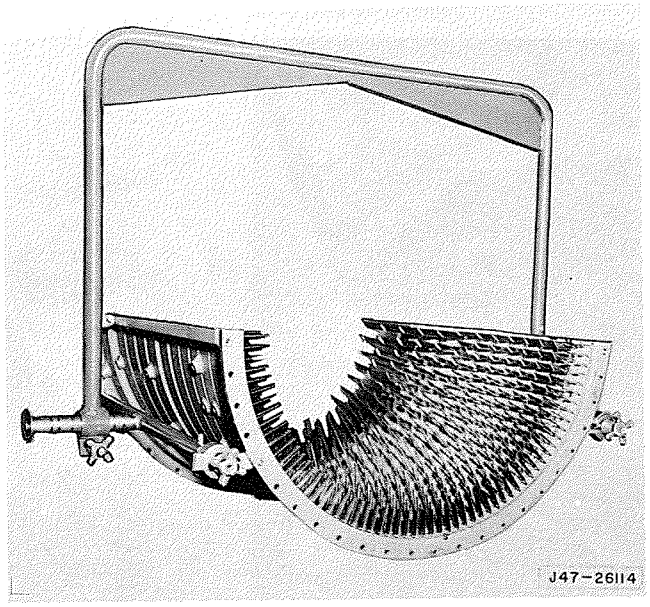


Figure 3–28. Compressor Stator Casing Installed in Sling 1C2025

Figure 3–27. Deleted

3–54. REMOVING AND DISASSEMBLING THE ISLANDS.

a. Remove and disassemble the No. 1 island as follows:

(1) Disconnect tachometer generator lead at the tachometer generator.

(2) On J47–27 engines, remove the junction box by disconnecting all leads. Remove junction box cover and remove the screws fastening the box to the island. Replace the cover on box.

(3) On J47–27 engines, remove the starter-generator cables from the island.

(4) Remove the No. 1 island from the front frame.

(5) Remove the connector from the island.

b. Remove and disassemble the No. 2 and 3 islands as follows:

(1) Disconnect all lines from the inboard side of the islands.

(2) Remove the islands from the front frame.

(3) Remove all fittings from the islands.

c. Remove and disassemble the No. 4 island as follows:

(1) Remove the control linkage clevis from the control shaft.

(2) Release the control shaft bearing by removing the bolts securing bearing to island.

(3) Remove the flex hoses connected to the islands.

(4) Remove the island from the front frame.

(5) Remove all fittings from the islands.

3–55. REMOVING ACCESSORIES FROM COMPRESSOR FRONT FRAME.

a. Remove the main fuel filter by disconnecting the lines at the filter. Install plugs in the filter openings.

b. Remove the regulator oil filter and orifice by disconnecting the lines at the filter. Then remove the hoses. Install plugs in the filter openings.

c. On J47–27 engine, remove the fuel manifold and hoses as an assembly as follows:

(1) Disconnect the hose at check and restrictor valve assembly.

(2) Disconnect the hose from the emergency discharge port of the fuel pump.

(3) Remove the manifold and disconnect the fuel hoses from the manifold.

d. Remove the main fuel control valve and connecting hoses. Remove the fittings and connectors from the valve.

e. Remove the lines connected to the fuel pump.

f. Remove the starter-generator and collar base from the front frame by loosening the Marmon clamp. Then lift the positioning lock, rotate the starter-generator

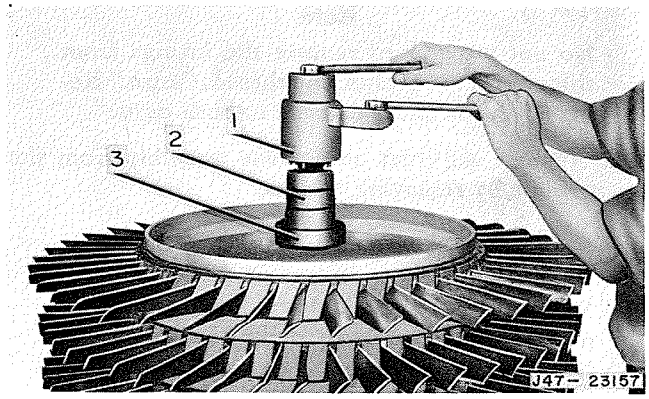


Figure 3-30. Removing No. 1 Bearing Spanner Nut with Wrench 1C783

(2) Remove all hoses and fittings from the regulator and stopcock.

(3) Remove the stopcock from regulator.

(4) Remove the regulator and plug the openings.

i. Remove the main lube pump as follows:

(1) Remove all hoses and fittings from the lube pump.

(2) Remove the tachometer generator from the lube pump.

(3) Remove the main lube pump.

j. Remove all the hoses connected to the front frame cover.

k. Remove the cover from the auxiliary drive pad.

3-56. REMOVING INLET GUIDE VANE ASSEMBLY.

Note

Rotate compressor front frame rear face up in disassembly stand 1C817.

a. Remove the 2 off-set tee flange connectors, gaskets, nuts and bolts from the compressor front frame.

Figure 3-29. Deleted

counterclockwise and remove the starter-generator. Remove the collar base and gasket.

CAUTION

Do not drop starter-generator adapter when removing this assembly.

g. Remove the fuel pump and gasket from the front frame and remove the connectors and fittings from the fuel pump. Install plugs in the openings.

h. Remove the main fuel regulator as follows:

(1) Remove the control linkage from the regulator and stopcock.

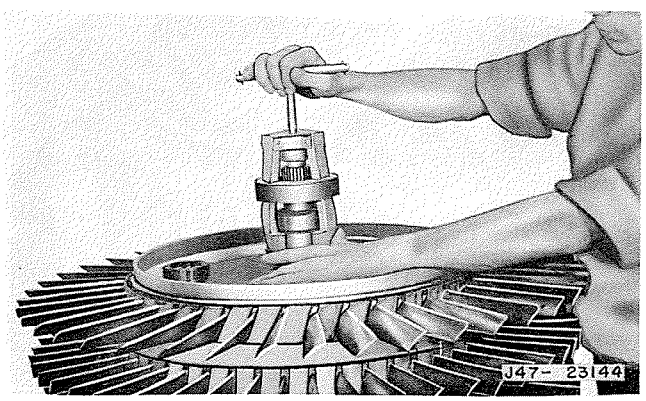


Figure 3-31. Removing No. 1 Bearing Inner Race and Oil Seal Hub with Puller 1C784

Note

Do not attempt to remove the fittings from this connector because the threads "seize." Removal would cause damage to both parts.

b. Remove the inlet guide vane assembly from the front frame by removing 4 bolts.

CAUTION

When removing the inlet guide vane assembly do not permit tools to strike the seal serrations. The seal is very soft and easily damaged. When available, install a locally manufactured protector or guard.

3–57. REMOVING NO. 1 AIR-OIL SEAL AND NO. 1 BEARING.

Note

The following steps should be followed if it is necessary to replace the No. 1 air and oil seal or the No. 1 bearing. For special tools, see Section II, group 9.

a. Remove 20 bolts and washers from the outer circle and 12 bolts and washers from the inner circle of the air and oil seal.

b. Remove the seal by threading 3 jack screws, 1C906, evenly into the threaded bosses on the outer circumference of the seal.

Note

As an alternate method if the jack screws are not available, the seal assembly may be removed by gripping the center opening with one hand and tapping in a radial direction gently with a non-metallic mallet.

c. Remove the lockwire from the No. 1 bearing housing. Remove the 6 bolts and washers and the 3 lugs which secure the No. 1 bearing to the compressor front frame.

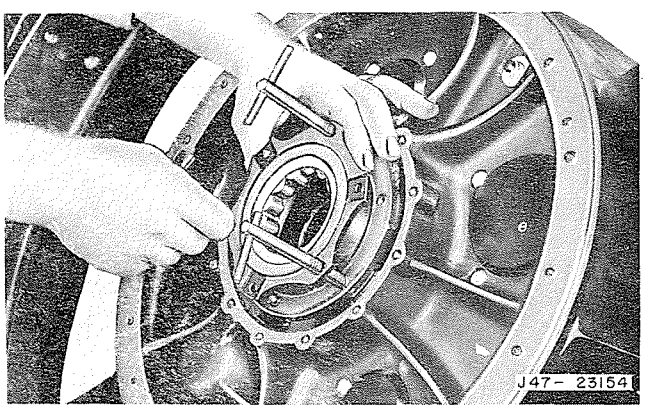


Figure 3–32. Removing No. 1 Bearing and Housing from Compressor Front Frame with Jack Screws 1C839

d. Remove the No. 1 bearing housing by threading 3 jack screws, 1C839, into the threaded tabs. (See figure 3–32.)

e. Remove No. 1 bearing outer race and roller assembly from the housing using pusher set 1C842. (See figure 3–33.)

3–58. REMOVING MISCELLANEOUS PARTS FROM COMPRESSOR FRONT FRAME.

Note

In the following paragraph all numbered references in parentheses refer to figure 5–2.

a. Rotate the compressor front frame forward face up in disassembly stand 1C817.

Note

Be sure to cut the lockwire from the relief valve, check valve, and magnetic drain plug. Breaking lockwire from these assemblies can cause damage by tearing away metal from the lockwire holes.

b. Remove the elbow (18), then remove the static pressure tap, nipple, and packing used on J47–27 engines, or the cover plate (23A) used on J47–23, –25 or –25A engines.

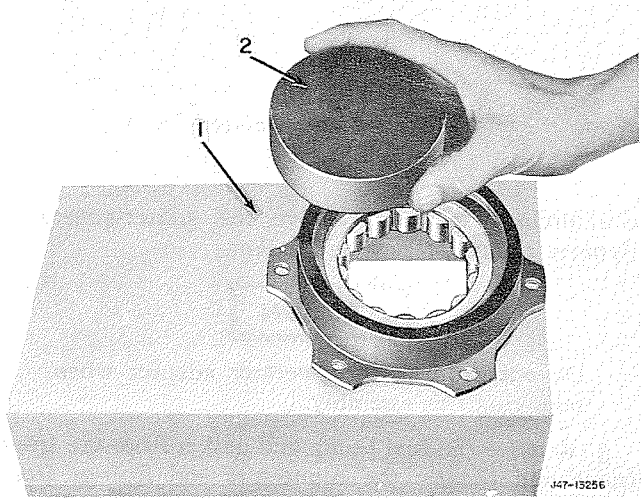
c. Remove 4 vent screens (12), 2 balance air port covers (14) and one vent cover (24).

d. Remove union, elbow and bleeder plugs from the double tee oil drain connector: then remove double tee oil connector (17) from the front frame.

e. Remove the bleeder plug and union (16) from the oil drain in the gearcase.

f. Remove 3 screen actuator cable bracket clips (15).

g. Remove 4 air inlet duct fairing brackets (3).



1. Base 1C842–1
2. Pusher 1C842–6

Figure 3–33. Removing No. 1 Bearing Outer Race and Roller Assembly from the Bearing Housing

h. Remove 4 anti-icing air duct assemblies, tubes, and seals (1).

i. Remove 3 anti-icing swivel elbows and gaskets (13).

j. Remove scavenge pump discharge elbow and gasket (6).

k. Remove "Y" drain connector and gasket (8) or union and gasket (8A).

l. Remove main fuel regulator lube supply reducer bushing, and gasket (11) and oil return union and gasket (5).

m. Remove auxiliary gearcase lube supply union (9) or bleed plug (9A).

3-59. DELETED.

3-60. DELETED.

Figure 3-34. Deleted

Figure 3-35. Deleted

Figure 3–36. Deleted

3–61. DISASSEMBLING SCAVENGE GEAR TRAIN.

Note

In the following paragraph, numbers in parentheses refer to figure 5–43. For special tools see Section II, group 26.

a. Remove the gear train cover (1) from gear train.

b. Remove the second reduction pinion and first reduction drive gear intermediate shaft (5), key (4) and rear bearing (3), by removing the snapring (2). Puller 1C602 when screwed into shaft, will help in this removal. (See figure 3–37.)

Note

Removing this shaft frees the second reduction pinion (7) and the first reduction gear (6) for removal.

c. Remove the front bearing (8) from the housing (15).

d. Remove the second reduction drive gear shaft (11), key (12) and the rear bearing (10) by removing the snapring (9) using puller 1C602.

Note

Removing the second reduction drive gear shaft (11) frees the second reduction drive gear (13) for removal.

e. Remove the front bearing (14).

3–62. COMBUSTION SECTION.

3–63. DISASSEMBLING COMBUSTION CHAMBERS.

a. On J47–23 engine chambers remove the inner liner out the rear end of the outer combustion chamber.

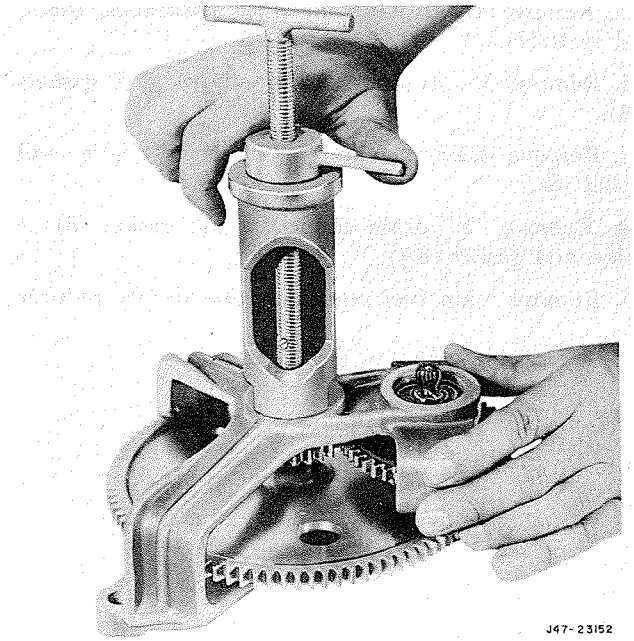


Figure 3–37. Removing Second Reduction Pinion and First Reduction Intermediate Shaft with Puller 1C602

On J47–25, –25A, and –27 engine chambers, remove the inner liner by removing the cross-ignition tubes and the exit ring bolts. Pull the liner out the rear of the outer combustion chamber. (See figures 3–38, 3–39, and 3–40.)

Note

Discard used exit ring bolts.

b. Remove the forward and rear drain fittings from the outer combustion chamber by reaching inside and removing the lockwire and the nut, washer, and gasket from each fitting.

Note

There are no forward drain fittings on chambers No. 3 and 6 of the J47–23 engines, or on chambers No. 2 and 7 on J47–25, –25A and –27 engines.

c. On J47–25 engines, remove the water-alcohol fluid injection nozzles from inside the outer chamber by removing the lockwire and the tabwashers and nuts.

3–64. TURBINE SECTION.

3–65. DISASSEMBLING TURBINE FRAME.

Note

In the following paragraph all index numbers in parentheses, refer to figure 5–78. For special tools see Section II, group 37.

a. Crank turbine frame into horizontal position in disassembly stand 1C632. (See figure 3-41.)

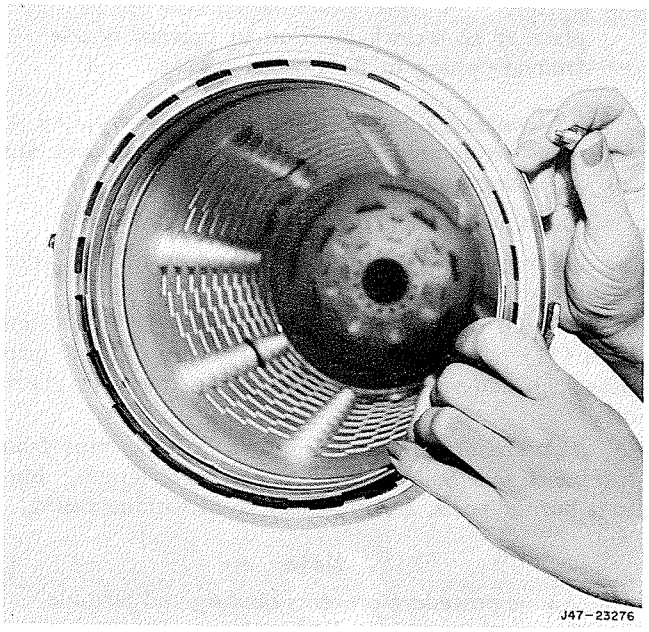


Figure 3-38. Removing Exit Ring Bolts

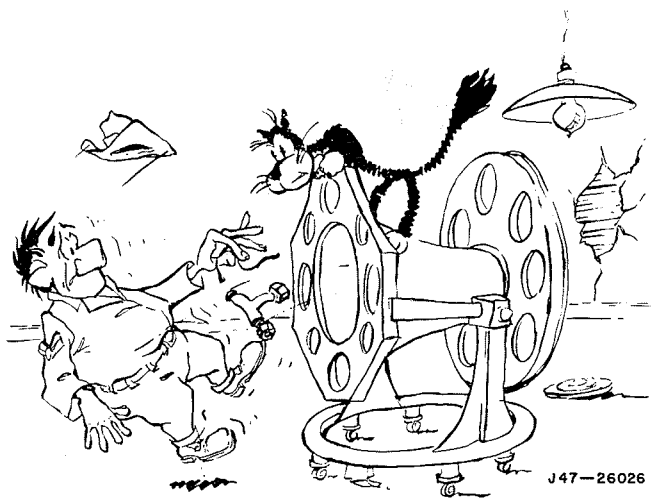
b. Remove turbine frame breather assembly (28) and eighth stage turbine wheel cooling air bellows (26).

c. Remove turbine casing connector drain (45); remove fittings from connector drain.

d. Remove No. 2 bearing oil jet and bracket assembly (1, 15).

e. Remove forward oil shield assembly (2).

f. Cut and remove all lockwire from No. 3 damper bearing oil jet assembly and forward oil feed tube.



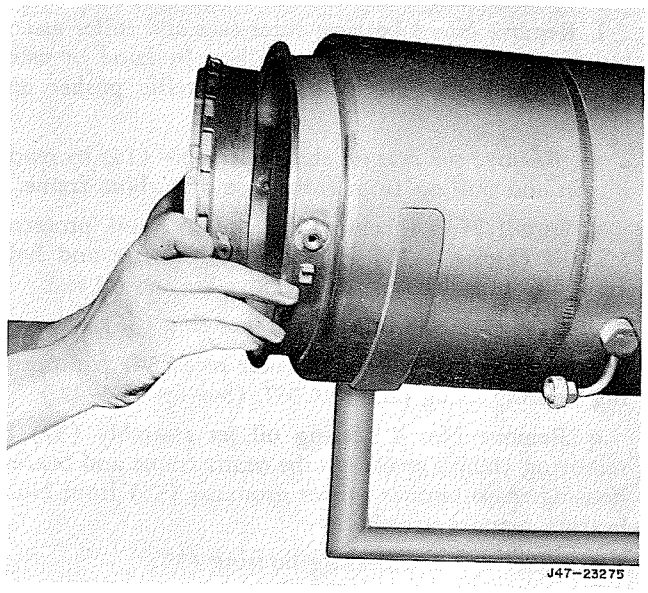


Figure 3-39. Removing Exit Ring

CAUTION

Be sure to cut lockwire from No. 3 bearing oil feed tube assembly as some connector fittings are aluminum and are easily damaged if lockwire is removed by breaking loose.

g. Disconnect No. 3 bearing oil jet (21) from tee connector and remove from damper bearing ring assembly.

h. Disconnect forward oil feed tube assembly (16) from lube inlet "T" fitting and No. 3 bearing oil tee and remove clamp (17) securing tube assembly to turbine frame.

i. Remove No. 3 bearing oil "T" (20) from No. 4 bearing lube feed tube assembly.

j. Remove No. 3 damper bearing assembly (7, 10, 11) from turbine frame by removing cotter pins, washers, spring guides, and spring.

k. Place damper bearing assembly on bench and remove bolts from rear side that secure retainer ring assembly to damper bearing.

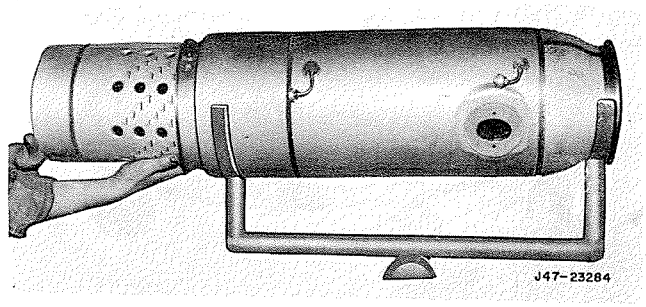


Figure 3-40. Removing Inner Combustion Chamber

l. Remove No. 3 bearing outer race and roller assembly from bearing housing by pulling by hand or using suitable holding fixture and non-metallic pusher and mallet.

m. Remove the rear oil shield assembly (14) by reaching in and pulling from front face of turbine frame.

n. Install No. 4 bearing air and oil seal protector 1C2014 (figure 2–15) and remove lockwire and bolts from air and oil seal (40). Remove air and oil seal.

o. Remove No. 4 bearing retainer ring (36).

p. Remove No. 4 bearing outer race (34) from bearing housing using puller 1C367. (See figure 3–42.)

q. Remove No. 4 bearing oil jet assembly (37) by removing clamps securing tube to aft frame and bearing housing. Also remove rubber grommet (35) from No. 3 bearing support assembly.

r. Remove No. 4 bearing housing (30).

s. Remove oil jet bracket (33) from bearing housing.

t. Rotate turbine frame rear face up in vertical position in disassembly stand.

Note

Turbine nozzle, casing, and transition liners may be removed with turbine frame in horizontal position if desired.

u. Remove the turbine nozzle, after removing bolts and air deflectors (43). Condemn the nozzle retaining bolts, after removal.

Note

If turbine frame is in horizontal position in disassembly stand, leave one bolt loose in place at 12 o'clock position to prevent nozzle from dropping to floor when prying.

v. Pry nozzle loose by using 2 pry bars placed 45 degrees apart located between upper nozzle flange and turbine casing rear flange.

w. Remove 8 anchor nut plates (29).

x. Remove the turbine casing and transition liners as follows:

(1) To remove turbine casing (41) and transition lines (31) remove transition locking wire (52) by gripping bent end with pliers and tapping free with plastic mallet.

(2) Disengage transition liner locking pins from turbine frame using plastic mallet and tapping liner into burner ports, freeing them from turbine casing.

Note

Above procedure prevents binding and possible damage to transition liners when turbine casing is being removed.

(3) Remove all bolts from forward flange of turbine casing and remove casing.

(4) Remove transition liners from turbine casing.

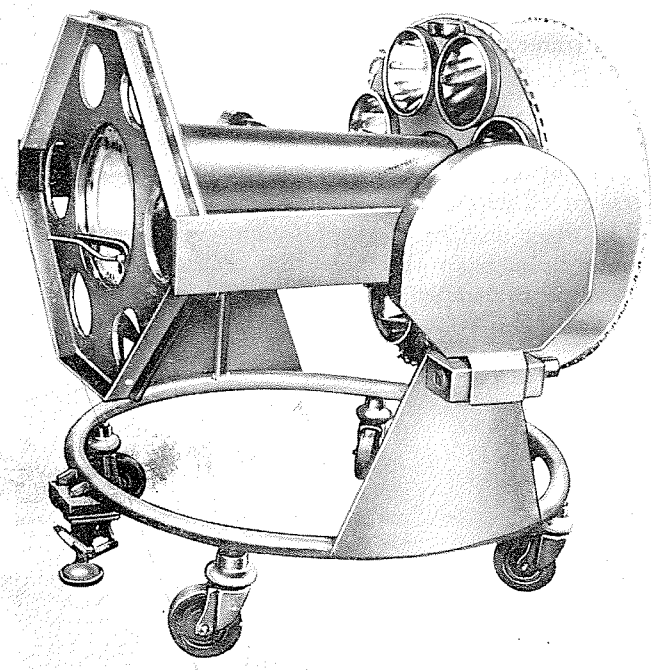
y. Disassemble and remove annular transition system as follows:

(1) To remove annular transition system remove all bolts from forward flange of turbine casing (41) and remove casing.

(2) Disconnect outer band (46) and remove from turbine casing.

(3) Disconnect inner band (47) and remove from transition liners.

(4) Remove 8 transition liners (48).



J47- 23261

Figure 3–41. Turbine Frame in Stand 1C632

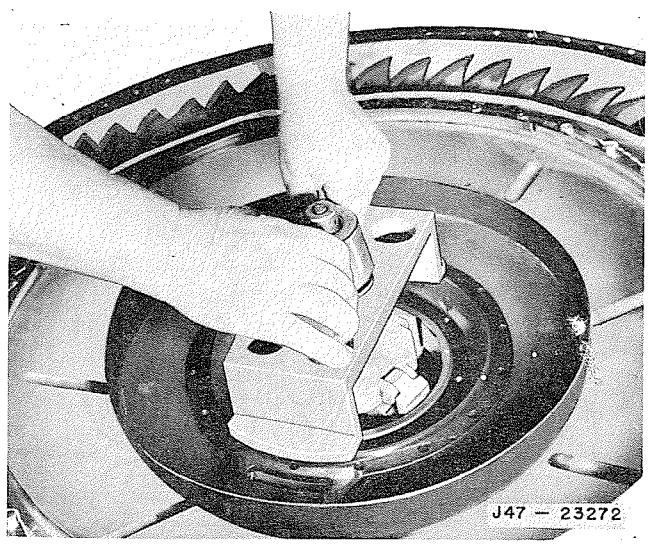


Figure 3–42. Removing No. 4 Bearing Outer Race from the Bearing Housing with Puller 1C367

3-66. DISASSEMBLING TURBINE ROTOR.

Note

In the following paragraph index numbers in parentheses refer to figure 5-83. For special tools see Section II, group 43.

a. Place turbine rotor (11) vertically on pallet with blocks to support turbine rotor or suspend turbine rotor horizontally from hoist using lift 1C980 (figure 3-11) attached to threaded hub on turbine rotor.

b. Using proper size Allen wrench remove both set screws (2) from No. 3 bearing locknut (1).

Note

If the body of the set screws has been damaged during prior assembly so that they cannot be removed with Allen wrench, the No. 3 bearing locknut can be removed with set screws installed. In this case screws should be removed during inspection and repair.

c. Remove the No. 3 bearing locknut using No. 3 bearing locknut wrench 1C668 and extension bar. (See figure 3-43.)

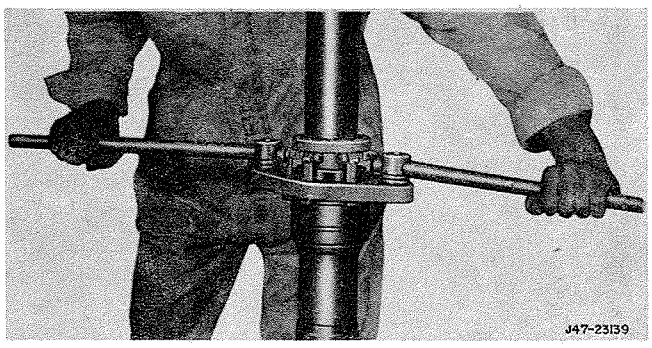


Figure 3-43. Removing No. 3 Bearing Locknut with Wrench 1C668

d. Remove the No. 3 bearing inner race (4) and shoulder ring (5) using No. 3 and No. 4 bearing inner race puller 1C986. (See figure 3-44.)

e. Remove both halves of the split ring (6) from turbine rotor shaft.

f. Straighten lockwasher tab (8) locking No. 4 bearing locknut (7) to turbine rotor.

g. Remove No. 4 bearing locknut and lockwasher using No. 4 bearing locknut wrench 1C667 and extension bar. (See figure 3-45.)

h. Assemble No. 3 and No. 4 bearing inner race puller 1C986 over turbine shaft and remove No. 4 bearing inner race (9). Place bearings in plastic bags.

i. Remove No. 4 bearing spacer (10). If spacer cannot be readily removed by hand, jacking screw holes are provided and spacer may be removed with suitable jacking screws.

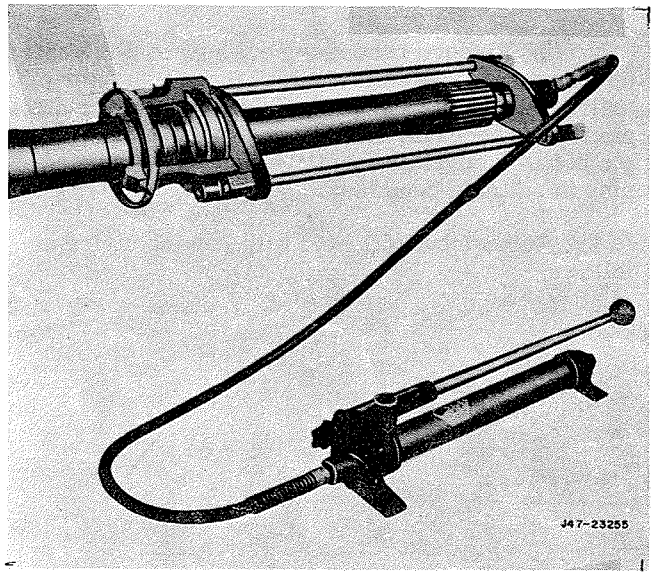


Figure 3-44. Removing No. 3 Bearing Inner Race with Puller 1C986

Note

The turbine rotor should be installed vertically on a pallet or horizontally in stand 1C982 when turbine buckets are being removed. Remove only those buckets which need to be replaced. The turbine rotor and the turbine buckets should be indexed prior to removal of any buckets to assure the reinstallation of buckets in the proper position on the turbine rotor.

j. Remove buckets with retaining pins as follows:

(1) Using suitable drifting tool and hammer, shear bucket retaining pin and remove turbine bucket from dovetail serration. Do not allow bucket to fall on hard surface.

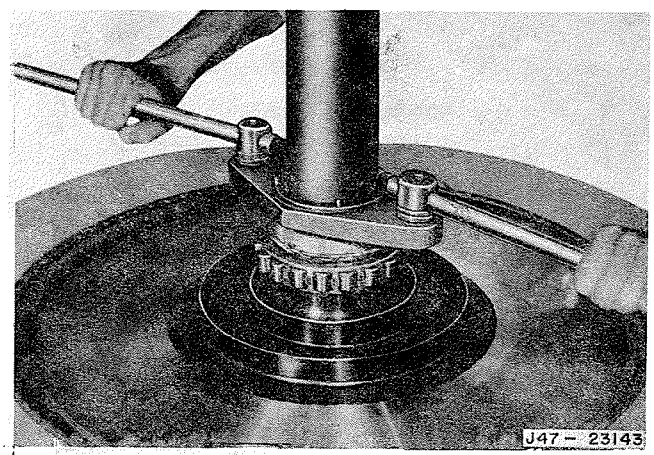


Figure 3-45. Removing No. 4 Bearing Locknut with Wrench 1C667

(2) Remove remainder of sheared pin from turbine rotor with suitable drift pin. Diameter of drift pin must not exceed 0.120 inch. Drive sheared pin from wheel rim inner flange to prevent damaging pin holes in dovetail serration. Catch discarded pins in suitable container.

k. Remove buckets held with locking strips as follows:

(1) Bend locking tab holding turbine bucket down and slide bucket from dovetail serration.

(2) Remove and discard used locking strip.

3-67. DELETED.

3-68. DELETED.

SECTION IV
CLEANING, INSPECTION, AND REPAIR

4-1. GENERAL.

4-2. PURPOSE OF INSPECTION. The purpose of inspection is to locate all the damage and defects that may exist in engine components. Close inspection is essential to insure safe engine operation and maximum performance.

4-3. EXTENT OF REPAIR. Inspection and repair limits at the field maintenance level are based on a general premise that repair of items need be made only where safety of flight is affected, or where such repair will materially add to the total life of the part. For the most part liberal limits are specified so that the necessity for repair is held to a minimum in order to conserve man-hours and still produce an engine capable of operating satisfactorily until the next major overhaul. Inspection personnel must exercise sound judgment and use common sense to avoid excessive expenditure of repair man-hours which is unwarranted from the standpoint of flight safety or achieving satisfactory operation until the next major overhaul. It must be kept in mind that if parts requiring repair were operating satisfactorily prior to tear down for field maintenance, they can undoubtedly be returned to service with a minimum of rework without jeopardizing engine life.

4-4. REPAIR AND REPLACEMENT. After each part of the turbojet engine has been cleaned and inspected, repair or replacement may be necessary to restore the engine to a serviceable condition. Correct replacement parts must be used, as not all parts are interchangeable. When repairing parts, follow the instructions carefully. Fit a precision part to its mating part during the repair operations so that it will match after repair. After repair, clean such parts thoroughly and slush with a rust preventive, such as a mixture of one part corrosive preventive compound (Specification MIL-C-6529, Type I) and three parts engine lubricating oil (Specification MIL-O-6081B, Grade 1005) or corrosion preventive compound (Specification MIL-C-6529, Type III). Cover openings with plastic caps, plugs, or masking tape.

4-5. USE OF TABLE OF LIMITS. The dimensions and clearances provided in the Table of Limits, Section VIII, are under the heading "Serviceable Limits". Replace parts which do not measure to serviceable limits. Base the serviceability of parts primarily upon visual inspection except where checks and measurements are specifically called for. If defects such as distortion, worn spots, and dents, etc., are noted during visual inspection, checking the dimensions may aid in determining seriousness of damage. A dimensional check may also aid in locating faulty parts if difficulty is encountered during assembly. Make a dimensional check of components where clearances are important to engine performance or where interference fits are required for assembly. Refer to the Table of Limits whenever measurements are taken during inspection.

4-6. DEFINITION OF TERMS. Terms frequently used to describe damage are given in table V. Column 1 of table V lists the terms used to describe deviations from normal conditions in engine parts. Column 2 defines the terms as used. Column 3 lists associated terms which although not technically identical, are definitely related in many ways.

TABLE V. DEFINITIONS OF DEVIATIONS

Handbook Term	Definition	Associated Terms
Blister	A raised portion of a surface caused by separation of the outer layers of the parent material or a coating applied to it.	Bubble Flaking Oxide formation Peeling Scale Slag inclusion (weld)
Brittle	A change in the resiliency of the parent material, usually due to aging, extreme heat, extreme cold, chemical action, or cold working (metal).	Cold worked Hard (like an old "O" ring) Stiff

TABLE V. DEFINITIONS OF DEVIATIONS (cont)

Handbook Term	Definition	Associated Terms
Buckle	A large-scale deformation of the original contour of a part, usually due to pressure or impact of a foreign object, unusual structural stresses, excessive localized heating, high pressure differentials, or any combination of these.	Ballooning Bend Blister (incorrect—see Blister) Bulge Crease Curl Dent (not to be confused with small-area defect in heavy material—see Dent) Depression Distortion (usually refers to heavy material) Elongated (usually refers to "out-of-round") Fold Indentation Kink (usually results in crack—see Crack) Protrusion (hollow) Rupture (result of excessive buckling) Uneven Warpage Wrinkle
Burn	A rapid destructive oxidizing action usually caused by heat application at higher temperatures than the parent material can structurally withstand. Change in color and appearance often indicates this condition.	Burn out (see Missing pieces) Erosion (chemicals or grit) Guttered Heat-check Heat curled Heat deterioration Hole (burn) Hot spot Overheated Oxidation
Burr	A rough edge or a sharp protrusion on the edge or surface of the parent material.	
Chip	A breaking away of the edge of the parent material, usually caused by heavy impact of a foreign object.	Break Nick (similar to Chip but no parent material is removed — see Nick) Notched Spalling (usually a flat surface breaking away — see Pit)
Corrosion	A mass of small pits which cumulatively create a large cavity (usually shallow) in the surface of the parent material.	See Pit
Crack	A parting of the parent material with or without deformation of the surrounding area.	Break Crater (usually found in castings) Fatigue damage Fissure Fracture Inclusion (usually found in castings) Lap (usually found in forgings) Rupture Separation Shear (not usually considered a crack — see Missing Piece) Slit Tear

TABLE V. DEFINITIONS OF DEVIATIONS (cont)

Handbook Term	Definition	Associated Terms
Dent	A completely smooth surface depression caused by pressure or impact of a smooth ball-like foreign object. The parent material is displaced but usually none is separated.	Peen
Deviation	An abnormal condition which causes a part to be other than the condition of a new part which agrees with the manufacturer's blueprint.	Damage Defect Flaw Imperfection Irregularity
Gall	A general term used to describe a defect caused by the movement of two surfaces in contact with one another. In most cases an accumulation of foreign material is deposited on the parent material.	See Pickup
Gouge	A general term used to describe a wide rough scratch or group of scratches, usually with one or more sharply impressed corners, and frequently accompanied by deformation or removal of parent material.	
Groove	A general term used to describe a long narrow continuous cavity or impression caused by pressure of a moving adjoining surface in contact with the parent material.	If impression is shallow and smooth — see Wear If impression is sharp — see Scratch
Loose	A part which has abnormal movement in relation to another.	Backed out Excessive movement Excessive play Insecure Leaks Loose fit Not tight Not torqued Shakes Sloppy Rattles Unbottomed Unpinned
Misaligned	A mismatching or malformation of any parts or mating parts which will either prevent perfect assembly, or result in faulty operation and/or ultimate part failure.	Eccentric Not axial Not concentric Out-of-round Unmatched Unsquare
Missing Piece	Removal or loss of a portion of parent material due to a combination of defects or damages.	Break (two or more pieces) Burn (burned away) Burn-out Corrosion (eaten away) Erosion (worn away) Guttered Hole Rusted (rusted away) Sheared Smashed Torn (torn away)
Nick	A surface impression with sharp corners or bottom, usually caused by pressure or impact of a sharp-edged foreign body. The parent material is displaced but usually none is separated.	Chip (see Chip) Dent (see Dent) Notch (see Chip)

TABLE V. DEFINITIONS OF DEVIATIONS (cont)

Handbook Term	Definition	Associated Terms
Noisy	An abnormal sound condition for moving parts; usually an increase in volume or a change of pitch.	Bumps (sound) Chatters Clicks Grates (usually gears) Grinds Hums Rattles (usually loose parts) Rubs (sound of rubbing) Scrapes (sound of scraping) Screeches Squeals Thumps (sound) Whistles
Obstructed	A condition which prevents free flow of a fluid-air, oil, fuel, water, etc, because of the presence of foreign material in the flow-path, or malformation in the flow member.	Clogged Contaminated Plugged Restricted
Pickup	The result of movement and/or the transfer of one material into or upon the surface of another. This is caused by: a. Contact between moving parts. b. Deposits of molten material on a cooler material.	Burr (usually tool-rub leaving high parent material) Gall (usually due to "a") High spot (if result of "a" or "b") Imbedment Inclusion (usually pickup of a dissimilar foreign material) Pile-up (usually due to "a") Protrusion (deposit on parent material) Metalization
Pinched	A condition caused by pressure on the parent material which usually results in distortion of one or more surfaces of the parent material.	Bound Compressed Flattened Seized (see Seizure) Smashed (without separation into pieces) Squashed Squeezed Tight
Pit	A minute depression or cavity, with no sharp high-stress corners, in the surface of the material. Pits are usually caused by chemical reaction (rusting, chemical corrosion, etc).	Corrosion Crater (usually in weld or casting) Dent (incorrect — see Dent) Electrolytic cavity Erosion (usually results in hole — see Burn) Fretting (see Wear) Inclusion (as in sand castings) Oxidation Perforation (usually in weld) Pock-marked Spalled Roughness
Rub	A general term used to describe a surface cavity or impression caused by two contacting surfaces moving against one another.	If impression is shallow and smooth — see Wear If impression is sharp — see Scratch
Scratch	A long, narrow, sharp-cornered impression caused by the movement of a sharp object across the surface of the parent material.	Abrasion Chafe Furrow Groove Rub Scarf Score

TABLE V. DEFINITIONS OF DEVIATIONS (cont)

Handbook Term	Definition	Associated Terms
Seizure	A welding or binding of two surfaces which prevents further movement.	Bound up Frozen Tight (see Pinched) Tight (fit) Wedged Welded (without external assistance)
Sheet-metal Dent	A large-area smooth depression in the parent material.	See Buckle
Unbalanced	A condition created in a rotating body by an unequal distribution of weight about its axis of rotation. Usually results in vibration.	
Varnish Film	A hard surface-film on metal, straw to very dark brown in color, built up by exposure to dry chemicals or fluids (commonly oil) while the part is heated above the breakdown point of the chemical or fluid.	Banded Discolored Oxidized Stained
Worn	A condition resulting from a relatively slow removal of parent material from any cause. Frequently, wear is not visible to the naked eye.	Abrasion Attrition (normal usage wear) Brinnelled Burnished Chafe Chattering Erosion (slow process by oxidation) Frayed Fretting Friction (interference) Gall Glazed Groove (smooth impression) Interference Oxidation Roughness Rub Scarfed Scraped Scuffed Touching Uneven wear Weak Worn thin

4–7. CLEANING.

4–8. CLEANING MATERIALS. The cleaning materials for removing carbon and cleaning steel, aluminum, and magnesium engine parts consist of a cleaning solution and tank as described in the following steps:

WARNING

The cleaning solution is composed of chemical compounds that are hazardous to breathe, will cause skin burns, and are inflammable. Wear protective clothing and equipment, such as rubber gloves, aprons, boots, and goggles during both mixing and cleaning operations.

a. The cold dip carbon remover cleaning solution is composed of 2 layers of liquid. (Refer to paragraph 4–9 for preparation of the solution.) The lower or active layer decarbonizes and removes heavy oil and grease. The upper layer or seal, consists of water with corrosion inhibitor added. The seal aids in pre-rinsing, retards the evaporation of the active lower layer, reduces toxicity, and absorbs most of the corroding contamination on the parts.

b. Cold dip carbon remover tank must be large enough for the work load and the physical dimensions of the part to be cleaned. (Refer to paragraph 4–10.) A suggested size is 4 feet long, 4 feet wide and 5 feet deep, containing approximately 4 feet of solution. The tank may be locally fabricated from steel and may include a pipe around the inside edge containing cold flowing water around the top inside edge for condensing vapors. There must be steam and hot water facilities and a hoist for handling the loaded baskets, and steam and hot water facilities must be provided.

4–9. PREPARATION OF COLD DIP CARBON REMOVER SOLUTION. The following directions are based on the tank size of 4 x 4 x 5 feet suggested in paragraph 4–5b. Since the active layer should be approximately 4 feet deep, the tank holds 4 x 4 x 4 = 64 cubic feet x 7.5 = 480 gallons of active solution and 10 percent, or 48 gallons of seal solution.

Note

In order to keep the elapsed time before the addition of the seal to a minimum, prepare the seal first, before mixing the ingredients of the active layer.

CAUTION

Use distilled water or soft water containing less than 10 parts of calcium carbonate per million in preparing the seal.

a. Prepare the seal in a separate container by dissolving 1-1/2 ounces of potassium chromate (K_2CRO_4) per gallon of water or 72 ounces in the 48 gallons. Add the potassium chromate slowly, while constantly stirring the water until completely dissolved.

b. Pour 240 gallons of cresol base engine cleaning compound, Specification MIL–C–5546A, into the tank.

c. Add 240 gallons of methylene chloride, Specification MIL–M–6998, and mix the two solutions thoroughly.

d. Add the 48 gallons of seal solution and allow to stand about one hour to permit the two layers to separate.

CAUTION

Never permit the depth of the seal to drop to less than 3 inches. Add distilled water to maintain the proper depth.

Note

Any volume of cold dip carbon remover solution may be prepared so long as the active solution consists of Specification MIL–C–5546A and MIL–M–6998 in a ratio of one to one and the seal solution as prepared in step "a" is 10 percent of the active solution.

4–10. CLEANING PROCEDURE. Clean engine parts such as combustion chambers, transition liners, cross-ignition tubes, inner connector tubes and gaskets, cross ignition bellows guards, clamping rings, drain fittings, exhaust cone, turbine nozzle, turbine casing, and turbine wheel and shaft using the following procedure.

a. Prevent contamination of the carbon remover solution by removing all loose oil, grease, and dirt from the parts with a suitable degreaser, such as steam, or a mixture of Specification 20015E and solvent.

b. Place the parts in a mesh basket, or suspend by wire, and immerse in the lower layer of the cleaning solution.

Note

Avoid agitation or excessive mixing of the two layers of cleaning solution.

c. Close the lid of the tank and allow the parts to soak for approximately 2 hours, depending on the hardness and extent of the deposits.

d. Raise the parts slowly, so that they come in contact with the upper layer for approximately 30 seconds, then remove from the tank.

e. Rinse the parts with hot water, followed by steam, and allow to dry.

f. Immediately after drying apply rust preventive of one part corrosion preventive compound, Specification AN–VV–C576 or MIL–C–6529, mixed with 3 parts engine oil, Specification MIL–O–6082.

4–11. DELETED.

4–12. DELETED.

4–13. DELETED.

4–14. DELETED.

4–15. DELETED.

4–16. DELETED.

4–17. DELETED.

4–18. DELETED.

4–19. DELETED.

TABLE VI. DELETED

4–20. DELETED.

4–21. DELETED.

4–22. DELETED.

TABLE VII. DELETED

4–23. DELETED.

4–24. DELETED.

4–25. DELETED.

Pages 71 through 74 deleted, figures 4–1 through 4–4 deleted.

4-26. SPOT FLUORESCENT-PENETRANT INSPECTION.

4-27. DESCRIPTION. This method is acceptable for detecting surface defects after repair, or for inspecting small areas where processing of the entire part would be impractical.

a. Materials required:

(1) Post-Emulsification Fluorescent Penetrant Oil, ZL-22A (Magnaflux Corporation, Chicago, Ill.), or equivalent.

(2) Use ZL-22A Penetrant Oil on rotating parts (titanium) compressor rotor disc and spacers, turbine rotor disc outer rim (dovetail slots) and turbine buckets.

(3) Use ZL-2A on sheet metal and stationary parts.

(4) Cleaner, ZC-7 (Magnaflux Corporation, Chicago, Ill.) or equivalent.

(5) Developer, ZP-4 or ZP-5 (Magnaflux Corporation, Chicago, Ill.) or equivalent.

NOTE

Magnaflux Corporation Kit No. ZA-43 contains a portable black light P/N ZB-23A (100 watt, 120 v.a.c.) together with a supply of penetrant oil, cleaner and developer.

b. Equipment required:

(1) Fluorescent-Penetrant Inspection Booth or ultraviolet light and attaching canvas with viewing slot.

c. Procedure:

(1) Remove all traces of scale, carbon, grease, oil or any other foreign matter that would adversely affect penetration of oil into defects.

(2) For inspection after repair, acid-etch area to remove any smeared metal per paragraphs 4-28 thru 4-32.

(3) Brush spray ZL-2A or ZL-22A penetrant oil onto surface.

WARNING

Penetrant oil flash point is relatively low (125°F) when oil in form of fine spray. Prevent exposing oil mist to elevated temperature (open flame, induction heat, etc.).

(4) Wait a minimum of 15 minutes for penetrant oil to enter defects, then brush or spray ZC-7 cleaner onto surface to remove excess penetrant oil.

NOTE

Inspect surface with ultraviolet light to be certain all excess oil is removed.

(5) Apply ZP-4 or ZP-5 developer onto surface.

NOTE

ZP-4 developer provides greater sensitivity than does ZP-5. ZP-4 may be applied by brushing or any other means that will suitably cover surface to be inspected. ZP-5 should be used when a wet developing method is desired.

(6) Wait a minimum of 5 minutes for development of indications; then place a canvas hood over surface, turn on ultraviolet light and inspect surface through viewing slot in hood.

NOTE

Use inspection booth if available.

WARNING

Radiation from ultraviolet light is harmless to the skin and eyes; however, the fluorescent-penetrant method of inspection tires the eyes. To alleviate this condition wear light green tinted goggles. Developing powder is not harmful to inhale, but may be annoying in heavy concentration. Dermatitis may result when the penetrant oil remains on the skin for several days, but may be avoided by using Neoprene gloves. The presence of penetrant oil on the skin may be detected under ultravoilet light.

(7) Circle defects with red layout fluid, chalk or other suitable marking device.

4-28. BLENDING PROCEDURE. Use an Arkansas stone, a small file, or crocus cloth for blending. Blend only in a radial direction in relation to the engine on turbine buckets, compressor rotor blades, and similar parts. A minimum thickness of 0.015 inch must be left on the edge being blended, and there must be no feather edges. Blend circular parts in a circumferential direction. The finished blend must be as close as is practical to the original finish of the part being repaired.

4-29. BLENDING OR FLUORESCENT-PENETRANT INDICATIONS OR CRACKS IN NON-MAGNETIC MATERIAL.

a. Do not attempt to remove the indication or crack in one blending operation. Blend in increments of 0.005 inch, and do not exceed the maximum blend depth for that area.

b. Acid-etch the area after each blending or grinding operation to remove smeared metal before inspecting per paragraph 4-26.

(1) Refer to paragraph 4-30, for high temperature material.

(2) Refer to paragraph 4-31 for aluminum alloy.

(3) Refer to paragraph 4-32 for magnesium alloy.

4-30. ETCHING OF IRON BASE, NICKEL BASE, AND COBALT BASE ALLOYS.

a. In plastic container mix the following (Schantz) solution to the following proportions.

WARNING

Do not permit etching solution to contact skin; severe burns will result.

Water:	75cc
Sulphuric Acid (95-98 percent, CP Grade):	15cc
Hydrochloric Acid (36.5-38 percent, CP Grade):	180cc
Nitric Acid (69-71 percent, CP Grade):	50cc
Acetic Acid (99.7 percent, CP Grade):	75cc
Ferric Chloride ($FeCl_3$-$6H_2O$-ACS):	45 grams

(1) Combine the water, sulphuric, and hydrochloric acid.

(2) Prepare (melt) the ferric chloride.

(3) Add the nitric and acetic acid to the combined acids and water of sub-step (1).

(4) Add the ferric chloride.

b. Mix the etching solution in a plastic container as follows:

(1) Mix 50 percent of Schantz solution step "a" with 50 percent hydrochloric acid (HCl): CP grade.

WARNING

Do not permit etching solution to contact skin; severe burns will result.

NOTE

Mix only that amount of etching solution that can be used within one hour and dispose of it after one hour.

c. Apply etching solution to blended area with a clean cotton swab.

d. Permit solution to remain on area for 1-1/2 minutes, then wash area thoroughly with water and dry with a clean lint-free cloth or filtered air.

4-31. ETCHING OF ALUMINUM MATERIAL.

a. In a plastic or glass container mix an etching solution to the following proportions.

(1) 10 percent oxalic acid and 90 percent water by weight.

WARNING

Do not permit etching solution to contact skin; severe burns will result.

b. Apply etching solution to blended area with a clean cotton swab.

c. Permit solution to remain on area for 1-1/2 minutes, then wash area thoroughly with water and dry with a clean lint-free cloth or filtered air.

4-32. ETCHING OF MAGNESIUM MATERIAL.

a. In a plastic or glass container mix an etching solution to the following proportions:

(1) 10 percent tartaric acid and 90 percent water by weight.

WARNING

Do not permit etching solution to contact skin; severe burns will result.

b. Apply etching solution to blended area with a clean cotton swab.

c. Permit solution to remain on area for 1-1/2 minutes, then wash area thoroughly with water and dry with a clean lint-free cloth or filtered air.

4-33. WELDING.

NOTE

Refer to Table VIII for the welding rod and process to use on engine parts.

TABLE VIII. WELDING DATA

Part Name	Parent Material	Welding Rod Designation: AMS Specification	Welding Rod Designation: Commercial Designation	Welding Rod Designation: USAF Approved Designation	Welding Rod Designation: G.E. Material Designation	Process	Remarks
Cowl, Accessory	Aluminum Alloy	4190A	43S Aluminum	QQ-R-566-CLFS-RA1-13	B21B4	Inert Arc	
Screen, Air Inlet	Carbon Steel (NAX)	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B21B7	Inert Arc	
	AMS 6354	AMS 6460	AWS Class No. E6012 Electrode	NAX Wire	B50R143J	Metallic Arc	Alternate
	Silver Brazed Joints	AMS 4770C	Silver-base-brazing alloy wire	AA-5-561 Class 4	B20F5 or B2059 (Flux A10B15)	Braze	
Sector, Air Inlet Duct	Aluminum Alloy	4190A	4043 Aluminum	QQ-R-566-CLFS-RA1-13	B21B4	Inert Arc	
Fairing, Air Duct	Aluminum Alloy	4190A	4043 Aluminum	QQ-R-566-CLFS-RA1-13	B21B4	Inert Arc	
Island Covers	Carbon Steel (NAX)	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B21B7	Inert Arc	
	AMS 6354	AMS 6460	AWS Class No. E6012 Electrode	NAX Wire	B50R143J	Metallic Arc	Alternate

TABLE VIII. WELDING DATA (cont)

Part Name	Parent Material	WELDING ROD DESIGNATION				Process	Remarks
		AMS Specification	Commercial Designation	USAF Approved Designation	G.E.Material Designation		
Duct, Anti-icing Air	Aluminum Alloy	4190A	4043 Aluminum	QQ-5-566-CLFS-RA1-43	B21B4	Inert Arc	
Turbine Frame	321 Stainless Steel	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B21B7	Inert Arc	
		AMS 5680B	327 S.S. Wire	MIL-R-5031 Class 5	B21B17A2	Inert Arc	
		AMS 5681A	347 Electrode	MIL-E-16715 Type 347	B21B30A2	Metallic Arc	Alternate
Outer Combustion Chambers	321 Stainless Steel	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B21B7	Inert Arc	
		5680B	347 S.S. Wire	MIL-R-5031 Class 5	B21B17A2	Inert Arc	
		5681A	347 Electrode	MIL-E-16715 Type 347	B21B30A2	Metallic Arc	Alternate
Inner Combustion Chambers	Inconel	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B2157	Inert Arc	
		5679B	Inconel Wire No. 62	MIL-R-5031 Class 8A	B21B75	Inert Arc	
		5684B	Inconel Wire No. 132	MIL-E-6855 Class 8	B50R283	Metallic Arc	Alternate
Inner Combustion Chamber (Ceramic Coated)	321 Stainless Steel	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B21B7	Inert Arc	
		5680B	347 S.S. Wire	MIL-R-5031 Class 5	B21B17A2	Inert Arc	
		5681A	347 Electrode	MIL-E-16715 Type 347	B21B30A2	Metallic Arc	Alternate
Cross-Ignition Tube (Elliptical)	Inconel	AMS 5786	Hastelloy W	MIL-R-5031 Class 8A	B21B7	Inert Arc	
		5679B	Inconel Wire No. 62	MIL-R-5031 Class 8A	B21B75	Inert Arc	
		5684B	Inconel No. 132	MIL-E-6844 Class 8	B50R283	Metallic Arc	Alternate
Cross-Ignition Inner Connector	Inconel	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B21B7	Inert Arc	
		5679B	Inconel Wire No. 62	MIL-R-5031 Class 8A	B21B75	Inert Arc	
		5684B	Inconel No. 132	MIL-E-6844, Class 8	B50R283	Metallic Arc	Alternate

TABLE VIII. WELDING DATA (cont)

Part Name	Parent Material	WELDING ROD DESIGNATION				Process	Remarks
		AMS Specification	Commercial Designation	USAF Approved Designation	G.E. Material Designation		
Turbine Casing	321 Stainless Steel	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B21B75	Inert Arc	
		5680B	327 S.S. Wire	MIL-R-5031 Class 5	B21B17A2	Inert Arc	
		5681A	347 Electrode	MIL-E-16715 Type 347	B21B30A2	Metallic Arc	Alternate
Turbine Casing	Carbon Steel (NAX) AMS 6354	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B21B75	Inert Arc	
		AMS 6460	AWS Class No. E6012 Electrode	NAX Wire	B50R143J	Metallic Arc	Alternate
Transistor Liner (Standard)	Inconel	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B21B75	Inert Arc	
		5679B	Inconel Wire No. 62	MIL-R-5021 Class 8A	B21B75	Inert Arc	
		5684B	Inconel No. 132	MIL-E-6844 Class 8	B50R283	Metallic Arc	Alternate
Transistor Liner Assembly (Annular)	Inconel and Incoly	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B21B75	Inert Arc	
		5679B	Inconel Wire No. 62	MIL-R-5031 Class 8A	B21B75	Inert Arc	
		5684B	Inconel No. 132	MIL-E-6844 Class 8	B50R283	Metallic Arc	Alternate
Turbine Nozzle	AMS 5385 and 321 S.S.	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B21B75	Inert Arc	
		5681A	347 Electrode	MIL-E-16715, Type 347	B21B30A2	Metallic Arc	Alternate
Ring, Turbine Shroud	321 Stainless Steel	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B21B75	Inert Arc	
		5680B	347 S.S. Wire	MIL-R-5031, Class 5	B21B17A2	Inert Arc	
		5681A	347 Electrode	MIL-R-5031, Class 5	B21B30A2	Metallic Arc	Alternate
Exhaust Cone	321 Stainless Steel	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B21B75	Inert Arc	
		5680B	347 S.S. Wire	MIL-R-5031, Class 5	B21B17A2	Inert Arc	
		5681A	347 Electrode	MIL-R-5031, Class 5	B21B30A2	Metallic Arc	Alternate
Tailpipe Clamp	321 Stainless Steel	AMS 5786	Hastelloy W	MIL-R-5031 CL12	B21B75	Inert Arc	
		5680B	347 S.S. Wire	MIL-R-5031, Class 5	B21B17A2	Inert Arc	
		5681A	347 Electrode	MIL-R-5031, Class 5	B21B30A2	Metallic Arc	Alternate

4-34. METALLIC ARC WELDING.

a. Clean all oil and grease from the surface to be welded. Remove other foreign material by wire brushing, grinding, or vapor blasting.

b. Remove any defect in the part. When welding a part thicker than 1/16 inch, chip, grind, or file out the damage. Inspect surface and make certain crack or other damage has been removed.

c. Weld the damaged area using the rod suited for the metal. The distortion caused by arc welding near finished surfaces may be avoided by placing wet asbestos packing around the area to be welded or by welding the part under water. Distortion may also be minimized by using copper backing.

d. After initial welding is complete, clean the weld. Remove undercutting, inclusions, cracks, slag pockets and other defects by grinding, filing, or chipping and then reweld.

4-35. INERT GAS ARC WELDING.

a. Inert gas, non-consumable electrode, arc welding may be used to repair-weld a part instead of the simple arc welding process. Either argon or helium gas is acceptable for shielding.

b. Bare (uncoated) welding rod (or wire) suitable for welding the particular metal should be available for filler metal if necessary.

c. Prepare the surface to be welded as outlined in paragraph 4-32a above.

d. Make the repair weld. Use filler metal only if necessary.

e. Anneal all welds of defects due to service stresses. Even welds of defects in lightly stressed parts should be annealed.

f. Undercutting, inclusions, cracks, slag pockets and lack of fusion must be repair welded after grinding, chipping or filing.

g. When a weld is in a critical area, inspect the repair by the fluorescent-penetrant method. Reweld if necessary.

4-36. SPOT WELDING (RESISTANCE).

a. Remove oxides or discoloration from the part to be welded by vapor blasting, dust blasting, wire brushing, or by other suitable methods.

CAUTION

Do not sandblast the part to be spot-welded. Sand impregnated in the surface will cause a poor weld.

b. Clean the surface to be welded with carbon tetrachloride.

c. Spot weld the part.

4-37. SEAM WELDING (RESISTANCE). Prepare a part for seam welding as instructed in paragraph 4-36.

4-38. BRAZING (TORCH). Clean the part thoroughly of all grease, paint, dirt, scale, or other foreign substances. Preheat the part with a neutral or slightly reducing flame to raise the temperature of the entire joint or surface uniformly to the flow temperature of the filler alloy. Use flux to promote free flowing of the filler rod.

4-39. GENERAL REPAIR PROCEDURES.

NOTE

The following refinishing procedures are outlined herein as a guide if facilities are available and authorized.

4-40. REFINISHING PAINTED SURFACES. Bonderize the area as described in paragraph 4-41, and repaint as necessary. Anodized aluminum parts do not need repainting if all paint has been removed and none of the anodizing is damaged or destroyed.

NOTE

Spot re-anodizing of aluminum surfaces is permissible.

4-41. TOUCH-UP BONDERIZING.

a. Prepare a solution consisting of 115 milliliters of Bonderite No. 160, or equivalent, for one gallon of water and mix the solution thoroughly. (Refer to table IX.)

b. Prepare a solution consisting of two grams of chromic acid for one gallon of water and mix the solution thoroughly.

c. Clean the area to be bonderized with a wire brush and trichlorethylene MIL-T-7003 (cold degreaser fluid may be used as a substitute for trichlorethylene).

d. Swab the Bonderite solution on at 71° C (160° F) with a nylon brush.

e. Allow the Bonderite solution to remain on for 5 to 10 minutes.

f. Rinse the solution off with running water or light spray.

g. Rinse the area with the chromic acid solution at 71° C (160° F) for one minute.

4-42. ALODINE PROCESS REFINISHING. The alodine process is used to touch up and protect reworked aluminum surfaces. It can be used in place of anodizing and is either brushed on the part or the part is dipped. Proceed as follows:

a. Clean the part as noted in paragraph 4-7.

b. Rinse the surface of the part with clear cold water and drain.

c. Heat the alodine solution to 55° C (130° F) and apply to the part by brushing or by dipping the part in the solution. Allow the solution to remain on the surface for 2 to 4 minutes.

d. Rinse the part surface in clear, cold water. If the surface is to be painted, use slightly acidulated water.

e. Dry the surface using compressed warm dry air. Allow the part to stand.

NOTE

Table IX provides a ready reference to bulk materials called for in this section and required for maintenance and repair of turbojet engines.

4-43. INSPECTION AND REPAIR OF MINOR COMPONENTS.

4-44. CONTROL LINKAGE.

4-45. INSPECTION.

a. Visually inspect the control rods for thread and spline damage, nicks and burrs, unauthorized bends or distortion, and loss of protective finish.

(1) Replace control rod if thread damage cannot be removed with a suitable die.

TABLE IX. GENERAL MATERIAL SPECIFICATIONS

Nomenclature	Specification No.
Alodine	MIL-C-5541
Anodize	AMSZ470C
Bonderize	AMS-2480
Chromic Acid	O-C-303 Type II
Compound Anti-Seize	MIL-L-25681
Compound Corrosive Preventive, Aircraft Engine Concentrated	MIL-C-6529, Type I
Compound Corrosive Preventive, Aircraft Engine	MIL-C-6529, Type III
Compound, Rust Preventive, Thin Film	MIL-C-16173A
Compound, Rust Preventive, Thin-Film-Finger Printing	MIL-C-15074
Dichromate	MIL-M-3171A
Enamel, Black, Heat Resistant	MIL-E-5557, Type I
Heresite (P-413)	None
Lubricant	MIL-G-23827
Oil, Lubricating, Aircraft, Gas Turbine Engines	MIL-L-6081B, Grade 1005
Oxide, Black	AMS-2485
Paint, GE No. 1212	None
Paint, Silicone Alum. GE No. 86009	AF Stock No. 8010-165-6552
Parco Lubrite	AMS-2481
Plating, Cadmium	QQ-P-416
Plating, Chrome	MIL-P-6871
Primer, Zinc Chromate	MIL-P-6889A, Type I
Solvent, Cleaning	Fed. Spec. P-S-661b (Superseded by P-D-680)
Thinner, Toluene, Commercial	Fed. Spec. TT-T-548a
Trichlorethylene	MIL-T-7003 (Superseded by O-T-680, Type II)

(2) Replace control rods with bends in the threaded or splined areas.

(3) Control rods with nicks or burrs are acceptable after removal of high metal.

(4) Replace control rods with damaged splines.

(5) Cadmium plate all control rods with protective finish missing as per Federal Specification QQ–P–416, if facilities are available.

b. Visually inspect the clevises for cracks, distortion, nicks and burrs, distortion and serration damage.

(1) Replace cracked or distorted clevises.

(2) Replace clevises with damaged, missing, or worn serrations.

(3) Accept, after removal of high metal, clevises with nicks and burrs.

c. Visually inspect the rod and bearings for cracks, thread damage, scratches, scores, nicks, burrs, defective bearings, and loss of protective finish on bearing housing.

(1) Replace rod end bearings with cracks in the housing or bearing.

(2) Replace bearing housing if thread damage cannot be removed with a suitable tap.

(3) Accept bearings with minute scratches or scores which cannot be felt with a 0.030 inch scribe. Replace rod end bearing when damage exceeds this limit.

(4) Accept, after removal of high metal, rod end bearings with nicks and burrs on the housing.

(5) Inspect rod end bearings for axial play. Replace bearing assemblies having over 0.005 axial play.

(6) Check rod end bearings for a binding or grinding condition. If detected, replace the bearings.

(7) Bearing housings lacking cadmium plating areas may be touched-up with G.E. 1212 paint (General Electric Co., Schenectady, New York) or equivalent. This protective finish is for the housing only.

d. Visually inspect the control linkage bolts, nuts, and washers for evidence of thread damage, wrench damage, distortion and excessive wear.

(1) Replace control linkage bolts and nuts with thread damage, wrench damage, or distortion.

(2) Replace washers exhibiting evidence of wear.

4–46. REPAIR.

a. Repair control rods and bearing housings with minor thread damage such as nicks and burrs by use of a suitable die or tap. Replace control rods and bearing housings if damage is beyond that which can be removed by this method.

b. Repair control rods, bearing housings, and clevises with nicks and burrs with a suitable file, stone, etc.

c. Wash rod end bearing assemblies in solvent Federal Specification P–S–661 to remove foreign material. While washing, bearing may be rotated up to 45 rpm.

d. Control rods may be cadmium plated (Federal Specification QQ–P–416) in areas lacking protective finish. Thread dimensions must be checked after plating. Bearing housings with exposed areas may be touched-up with G.E. 1212 paint (General Electric Co., Schenectady, New York) or equivalent. This protective finish is for the housing only.

e. After repair, inspect the control linkage for damage as outlined in paragraph 4–45.

4–47. TUBING. (MISCELLANEOUS ALUMINUM AND STEEL.)

4–48. INSPECTION.

a. Inspect miscellaneous aluminum and steel tubing for dents, nicks, flattening, die marks, splits, seams, and cracks.

(1) Replace tubing which has die marks, splits, seams, and cracks.

(2) Accept, after removal of high metal, tubing with nicks not in excess of 1/10 of wall thickness. Replace parts with nicks in excess of this limit.

(3) Accept tubing with dents not exceeding 1/5 the tube diameter, provided it is not on the heel of a sharp bend radius. Rework tubing with dents in excess of 1/5 the tube diameter.

(4) Accept tubing with flattening or out-of-round conditions not exceeding 1/4 the original tube diameter. Rework damage exceeding this limit if economically possible.

b. Inspect aluminum tubing for damage to protective finish. Damage may be repaired.

Note

Inspect the coupling nuts and sleeves for damage. Accept tubing with sleeves frozen to the nuts, provided the nut and sleeve are free to slide and the sleeve is bottomed in the nut. Clean the tubing by an approved method. Replace cracked sleeves with the following exception: cracked sleeves may be continued in service on de-icing tubing.

4–49. REPAIR.

a. If tubing has dents exceeding 1/5 of the tube diameter or flattened beyond 1/4 of the tube diameter, reform it to the original contour. Do not replace the part for shallow dents remaining after reforming. Replace the tube if it cannot be economically reformed to the original contour.

b. Accept nicks not exceeding 1/10 of the wall thickness of the tube after removing high metal.

c. After repair, inspect tubing as outlined in paragraph 4–48.

4–50. ELBOWS, UNIONS AND FITTINGS.

4–51. INSPECTION. (See figure 4–5.)

a. Inspect for thread damage. One half the entrance thread may be completely removed, provided the balance of the threads are not defective. If the entrance thread is not defective, the total of defects in the balance of the

threads will not exceed 1/4 of one thread. Rework all acceptable thread damage. (See sketch A, figure 4–5.)

b. Inspect for burred or damaged wrench pads. Rework damage on any wrench pad not exceeding 3/4 the width of the damaged corner. (See sketch B, figure 4–5.)

c. Inspect fittings for wrench or vise damage. Replace part if obvious wrench marks are evident. (See sketch C, figure 4–5.)

d. Inspect the mating surfaces for burrs, circumferential grooves, nicks, and gouges. Rework parts exhibiting damage, provided the damage can be removed without machining the 37-degree sealing surface

closer than 1/16 inch of the first thread. (See sketch D, figure 4-5.)

4-52. REPAIR.

a. Rework thread damage with a file, die, or tap.

b. Remove nicks and burrs on fittings with a file.

c. Remove damage on the 37-degree sealing surface by refacing. The 37-degree sealing surface must not be closer than 1/16 inch of the first thread.

Note

If necessary, remove material from the shoulder of male fittings to allow clearance for seating.

d. After rework, all aluminum parts may be touched-up with alodine, anodize, or five per cent chromic acid solution.

e. Inspect all elbows, unions, and fittings after rework as outlined in the inspection paragraph 4-51.

4-53. DE-ICING, FLUID INJECTION AND FUEL MANIFOLDS.

4-54. INSPECTION.

a. Inspect the fluid injection, de-icing and fuel manifolds for cracks by subjecting them to a hydrostatic test at the following pressures if facilities are available.

Manifold Assembly	Test Pressure
Fluid Injection	600 psig
De-icing Manifold	100 psig
Fuel Manifold (Large and small slot)	1000 psig

b. Replace the manifold if cracks are found in the tubing. Repair cracks in the welds. Replace cracked connector.

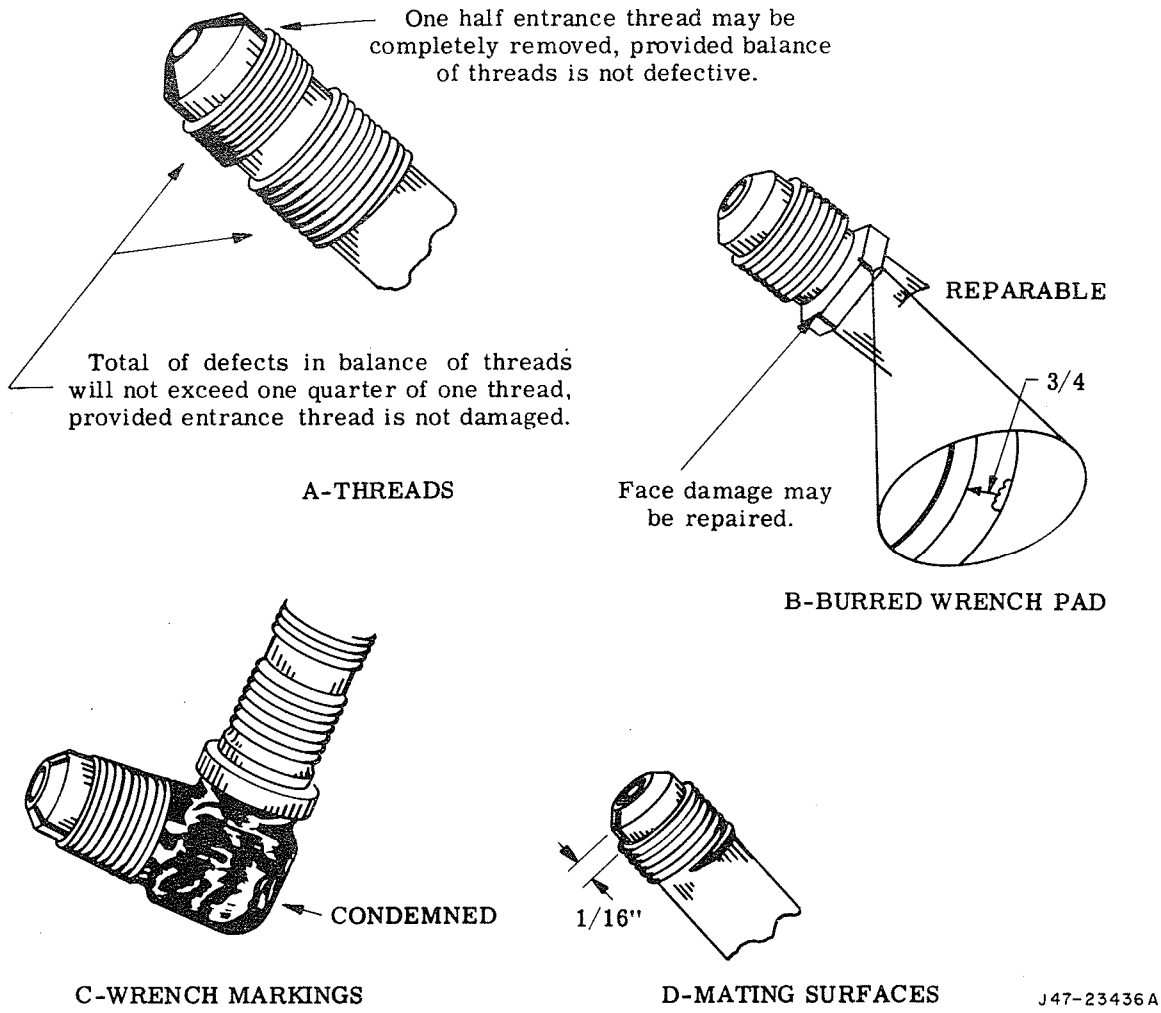

One half entrance thread may be completely removed, provided balance of threads is not defective.
Total of defects in balance of threads will not exceed one quarter of one thread, provided entrance thread is not damaged.
A-THREADS
REPARABLE
3/4
Face damage may be repaired.
B-BURRED WRENCH PAD
CONDEMNED
C-WRENCH MARKINGS
1/16"
D-MATING SURFACES
J47-23436A

Figure 4-5. Inspection of Elbows, Unions and Fittings

c. Inspect the manifolds for nicks and dents as follows:

(1) Accept, after removal of high metal, nicks not exceeding 1/10 of the wall thickness. Replace the manifold if nicks are in excess of this limit.

(2) Accept the de-icing manifold with dents not in excess of 1/5 of the tube diameter. Accept dents in the fuel and water injection manifolds not in excess of 1/10 of the tube diameter. Replace manifolds with dents in excess of these limits.

d. Inspect the manifold connectors for thread and seat damage.

(1) Accept one superficial nick or mark in vertical pattern per seat on de-icing manifold connectors, if it does not extend more than 3/4 the distance across the sealing surface. Replace the connector if the circumferential scores on the seat can be detected with the fingernail and superficial nicks or marks are beyond limits. Replace the connector if seat damage is detected on connectors on the fuel and water injection manifolds.

(2) Thread damage on the manifold connectors must not exceed 1/2 the entrance thread, if the remainder of the threads are free of damage. If the entrance thread is not defective, the balance of the thread damage will not exceed 1/4 of one thread. Remove minor nicks and burrs with a suitable die. Replace connectors with thread damage beyond acceptable limits.

e. Inspect the de-icing manifold flange for damage and distortion. Replace cracked flanges. Rework minor distortion or damage on the face of the flange.

f. Inspect the fuel and water injection manifold connector nuts, sleeves, and flares as follows:

(1) Inspect the connector nuts for cracks, defective threads and wrench damage. Replace the manifold assembly if the connector nuts are cracked. One half the entrance thread on the nut may be completely removed, provided the balance of the threads are not defective. If the entrance thread is not damaged, the total of defects in the threads will not exceed 1/4 of one thread. Rework all thread damage. Replace the manifold assembly if thread damage is beyond limits.

(2) Inspect sleeves for damage. Accept manifold connector if the sleeve is frozen to the nut, provided that the nut and sleeve are free to slide and that the sleeve is bottomed in the nut. Replace coupling nuts and sleeves if cracked, or replace the manifold.

(3) Inspect the flare on the manifold tube for cracks, burrs and distortion. Replace manifolds containing cracked or distorted flares.

g. Inspect sleeves on fuel drain lines and anti-icing air tubes for cracks. Accept one crack per sleeve provided there is no deformation on the tube flare. Replace lines and/or tubes having more than one crack per sleeve or if flare is distorted.

4–55. REPAIR.

a. If pressure checking facilities are available repair cracks in the manifold welds and braze as follows:

(1) The connector must be removed from the manifold and rebrazed if there are cracks in the fuel manifold to connector braze. After brazing, make sure the orifice of the connector and the manifold are not restricted by silver solder and the hole in the manifold and the hole in the connector are concentric.

(2) Repair cracks in the fluid injection manifold to connector welds by the inert arc process. Repair cracks in the weld securing the supports to the manifold by either inert arc or metal arc process.

(3) Repair cracks in the de-icing manifold welds by the inert arc process.

b. Rework nicks not in excess of 1/10 of the wall thickness by removing the high metal.

c. Remove minor nicks or burr damage to the threads of the connector with a suitable tool.

d. Machine de-icing manifold flanges exhibiting minor distortion or damage, provided that a minimum flange thickness of 0.180 inch can be maintained. Replace flanges that cannot be re-faced. After replacing the flanges, grind the excessive weld on the inside of the tube to the contour of the tube.

e. Replace connectors damaged beyond repair. After welding or brazing make sure the manifold and connector passages are not blocked with weld or braze and the hole in the connector is concentric with the hole in the manifold.

f. Refinish or touch up de-icing manifolds with damaged protective coating with alodine, anodize or 5 per cent chromic acid solution.

g. If the manifolds were welded during repair, inspect the assemblies to the limits specified in paragraph 4–54, including hydrostatic test. Visually inspect manifolds reworked without welding to the limits in paragraph 4–54, omitting the hydrostatic test.

4–56. METAL BRAIDED TUBING. (FLEXIBLE STEEL LINER.)

4–57. INSPECTION.

Note

Replace the metal braided tube assemblies if the bellows section, rigid tube section, nuts or sleeves, are damaged beyond repair limits. However, if replacement sections or parts are available, the tube assemblies may be disassembled and the defective section or part replaced.

a. Inspect the metal braided tubes for leaks by subjecting them to the following pressure tests if facilities are available.

System	Test Pressure
De-icing System Tubes	200 psig
Fuel System Drain Tubing	100 psig

(1) Submerge the turbine frame drain tube (P/N 8482959) in water and test for evidence of leakage using 35 psig air pressure.

b. Inspect the coupling nuts and sleeves for damage as follows:

(1) Wrench damage on each hexagon section of the coupling nut is not to exceed one corner, and 3/4 width of the corner must remain after rework. Rework nicks and burrs on the hexagon section.

(2) Rework threads having pickups or burrs. One half of the entrance thread may be completely removed, provided that the balance of the threads are not defective. If the entrance threads are not defective, damage in the balance of the threads must not exceed 1/4 of one thread. Rework all damaged threads.

Note

Inspect the coupling nuts and sleeves for damage. Accept tubing with sleeves frozen to the nuts, provided the nut and sleeve are free to slide and the sleeve is bottomed in the nut. Clean the tubing by an approved method. Replace cracked sleeves with the following exception: cracked sleeves may be continued in service on de-icing tubing.

c. Inspect the rigid tube section of the assembly for nicks and dents as follows:

(1) Accept, after removal of high metal, nicks not in excess of 1/10 the metal thickness. Replace tubes with nicks exceeding this limit.

(2) Accept, without repair, tubes with dents less than 1/5 the diameter, if the dents are not on the heel of the sharp bend radius. Replace tubes with dents in excess of this limit.

d. Inspect the braided section of the tube assembly for damage as follows:

(1) Accept tubes with less than 5 broken or damaged wires. Rework tubes if more than 5 and less than 10 wires are broken or damaged. Replace tubes with more than 10 damaged or broken wires.

(2) Repair holes in the braid less than 1/16 inch in diameter, if no two holes are closer than 1/2 inch. Replace tube assemblies with damage exceeding this limit.

e. Inspect the flange on the turbine frame drain tube for warpage. Rework the flange if it is not within 0.005 inch of true flatness.

4-58. REPAIR.

a. Disassemble braided tube assemblies as follows:

(1) Strip the cadmium plating from those tube assemblies having this type of protective coating.

WARNING

The cadmium plating must be removed from the braided tube assembly before heating it with a torch, since the cadmium leaves an undesirable residue, and fumes from the burning cadmium may be detrimental to the health of personnel.

(2) Place the tube in a suitable holding fixture.

(3) Melt the silver solder securing the rigid tube to the bellows section using an acetylene torch with a number 00, or equivalent, tip.

(4) Remove the flared tube from the braided section.

(5) Grind the remaining solder from the tube.

(6) Select the replacement part with the utmost care. It must equal the configuration of the damaged part in all respects.

(7) Place the assembled parts in a suitable fixture and silver solder the tube to the bellows section.

Note

Check the length of the tube assembly to make sure it agrees with the original configuration.

(8) After brazing, clean the tube assembly thoroughly and refinish those assemblies needing cadmium plating.

b. Rework wrench damage on each section of the hexagon coupling nut with a suitable file. After rework, 3/4 of the width of the damaged corner must remain. Rework acceptable thread damages with a suitable tap.

c. Remove high metal from nicks and burrs not exceeding 1/10 of the wall thickness of the tube.

d. Secure loose metal wires to the metal braid with silver solder. Cut wires to approximately 1/4 inch before brazing to the metal shielding. Use a minimum of solder.

e. Re-face turbine frame drain tube flanges that are not within 0.005 inch of true flatness.

f. After rework involving brazing, inspect the hose assembly as outlined in the inspection section. After minor rework, visually inspect the assembly as outlined in paragraph 4-57, omitting the pressure tests.

4-59. INSPECTION AND REPAIR OF FLEXIBLE HOSES AND SILICONE COUPLINGS.

4-60. INSPECTION.

Note

Inspect all installed rubber hose, fuel, oil, air, and hydraulic. (Teflon hose assemblies are not affected by age control.) Replace hose if the following conditions exist: (1) Evidence of deterioration; (2) age exceeds 5 years from installation date stamped or etched on flat surface of each end fitting socket; (3) age cannot be determined. Installed hoses or hoses removed to facilitate maintenance accepted in accordance with above criteria will be continued in service. All other hoses will be inspected as follows:

a. Inspect for leaks all AN6264 and MS28741 series hoses (Specification MIL-H-5511) and hose assemblies utilizing Aeroquip Type 601 hose by subjecting them to a hydrostatic test, using a testing fluid conforming to Specification MIL-O-6082, Grade 1120, or Specification MIL-O-5606, or equivalent. No leakage is permitted. Replace defective hoses or rework them to a shorter length depending on the nature of the damage. Test the hoses to the pressure below. Hold these pressures for 30 seconds duration.

Hose Size No.	Test Pressure PSIG
— 4	1500
— 6	1500
— 8	1500
—10	1500
—12	1500
—16	1000
—20	750
—24	375

b. Inspect high pressure hydraulic hoses AN6292 (Specification MIL-H-5512) for leaks by subjecting them to a hydrostatic test at 8000 psig pressure. Hold this pressure for 30 seconds duration. Replace defective hoses. If facilities are available, rework the hose to shorter lengths.

c. Visually inspect the hose connections and seats for nicks, pits, thread damage, and wrench damage.

(1) Accept one superficial scratch or mark in a vertical pattern in the hose seat, if it does not extend 3/4 the distance across the seat.

(2) Accept 4 nicks in a seat, provided they do not form a continuous pattern across the seat.

(3) Accept 3 pits in the outer 1/2 of the hose seats. The bottom 1/2 of the flare must be free of pits.

(4) Hose seats must be free from burrs, vertical tool marks and annular tool marks.

(5) Only one corner on each hexagon section of coupling nuts may show wrench damage, and 3/4 the width of this corner must be intact. Remove nicks and burrs in the hexagon section.

(6) Rework coupling nut threads having pickup or burrs. One-half the entrance thread may be completely removed, if the balance of the threads are not defective. If the entrance thread is not defective, damage in the balance of the threads must not exceed 1/4 of one thread. Rework all damaged threads.

d. Accept hoses which successfully pass the hydrostatic test and have minor cuts or abrasions (1/8 inch to 1/4 inch in length) on the outside of the braid, provided the rubber hose is not damaged. Replace the hose if the rubber is damaged.

e. Pressure check silicone rubber couplings (air lines) for 2 minutes with an internal air pressure of 100 psig with the part submerged in water. As an alternate method, test the coupling at 100 psig pressure with water as a testing medium. The pressure drop due to leakage over the 2 minute period must not exceed 10 psig. Replace the part if the pressure drop exceeds this limit.

4-61. REPAIR.

a. Rework defective hoses to shorter lengths and replace damaged parts. Proof test all hoses after rework as outlined in the inspection section.

b. Remove wrench damage on the hexagon sections of the coupling nuts with a suitable file. After rework, 3/4 the width of the damaged corner must remain. Only one corner may be reworked and all file marks must be removed. Remove high metal from connector ID using a reamer or other suitable tool.

c. Rework acceptable thread damage with a suitable tap or file.

d. Visually inspect all hoses for minor damage after rework. Pressure test and visually inspect all hoses newly fabricated or reworked to shorter lengths as outlined in paragaprh 4-60.

e. Reidentify all new fabricated hose by using marking procedures contained in T.O. 42E1-1-1.

4-61A. INTERNAL AND EXTERNAL SPLINES.

4-61B. INSPECTION AND REPAIR.

a. Inspect splines for nicks and burrs. Remove high metal from nicks. Remove burrs.

b. Inspect spline teeth for wear. Accept wear not to exceed 1/3 the original tooth width.

Note

Use a 6-inch scale and compare with an unworn spline to determine the amount of wear. Spline teeth should remain true and have no bend in the worn area. Replace parts if this limit is exceeded. Inspect fuel pump splines as directed in paragraph 4-332F.

4-62. BEARINGS.

Note

Matching of serial numbers of J47 No. 3 and No. 4 bearings, either during depot repair or turbine wheel changes, is not required. T.O. 44B-1-15 does not apply.

4-63. CLEANING. Remove normal grease and carbon from bearings by washing with solvent, Fed. Spec. P-S-661b. Remove heavy carbon by soaking bearing in carbon remover, MIL Spec. 20043A, or equivalent. After cleaning, flush with rust preventive solution of one part corrosive preventive compound, MIL Spec. C-6529, and 3 parts engine oil, MIL-O-6081A, grade 1005 or 1010.

4-64. INSPECTION.

a. Inspect bearings for damages noted in table X. Replace bearings having damage in excess of these limits.

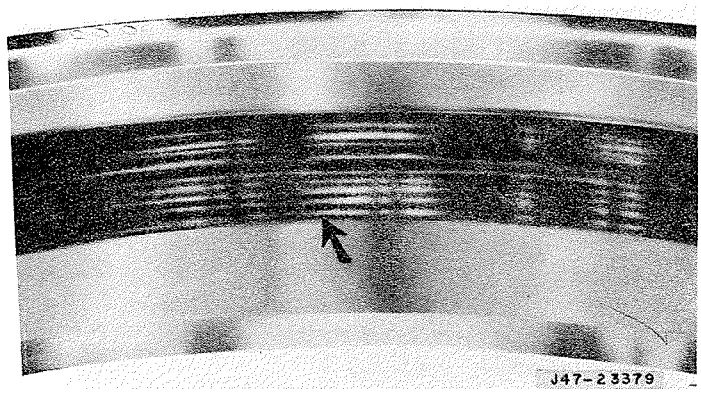


Figure 4-6. Banding

b. Carefully examine bearing retainers for cracks. If cracks are found, replace the assembly.

TABLE X. BEARING DAMAGE IDENTIFICATION AND SERVICE LIMITS

Description	Probable Cause	Serviceable Limits
Banding occurs on rolling contact surfaces of the bearing component parts, and may be recognized by even parallel bands of harmless discoloration on the rolling surface. The original surface is not broken.	Banding results from uneven formation of oil varnish or oxide film on bearing surfaces, generally due to high-temperature operation of the bearing.	Unlimited.

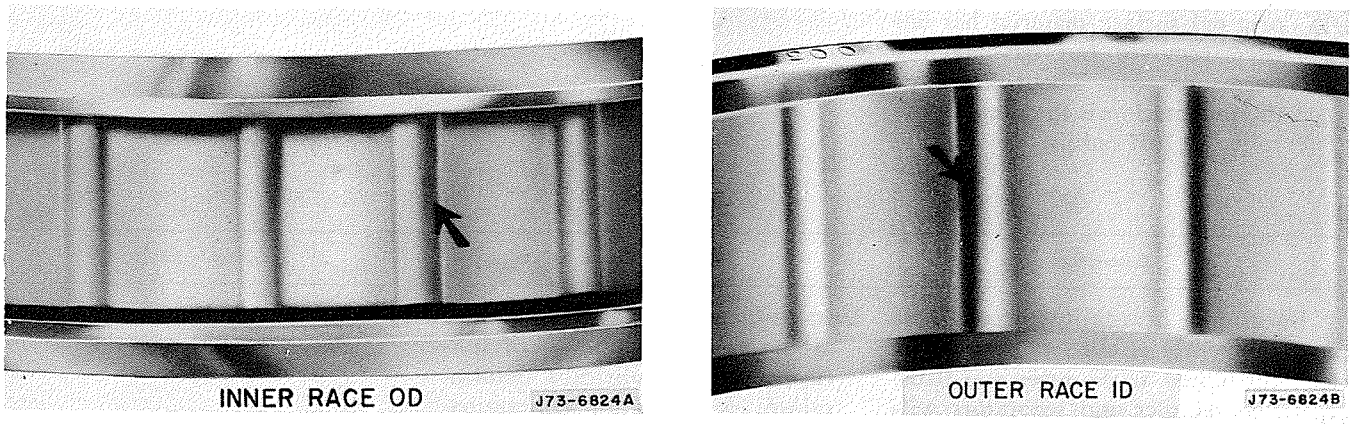


Figure 4–7. Brinelling—False

Description	Probable Cause	Serviceable Limits
False brinelling, a specialized form of fretting, occurs only at the rolling races, and may be recognized as a series of shallow indentations in the race at each roller position on the loaded side of the bearing. These indentations usually have a polished or satin-finish appearance showing removal of the original surface material. The contour of the indentation may be flatter than the roller radius due to very slight rotational roller movement. Very often red oxide of iron may be found where false brinelling has occurred.	False brinelling results from continued nonrotational shaft oscillations of small magnitude, generally due to nonrotational vibration. Vibration from a transporting vehicle carrying a nonoperating engine will often cause false brinelling. The causes of false brinelling are varied, but the final result is always attrition or the gradual removal of extremely small particles of the original surfaces at the point of contact. (False brinelling does not occur when a bearing constantly rotates or during operation.)	Any damage that cannot be felt with bearing probe.

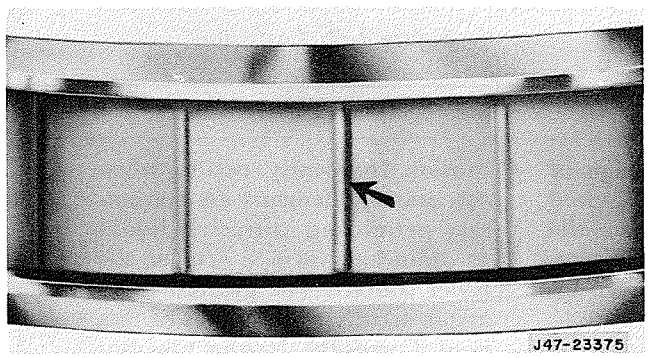


Figure 4–8. Brinelling—True

TABLE X. BEARING DAMAGE IDENTIFICATION AND SERVICE LIMITS (cont)

Description	Probable Cause	Serviceable Limits
True brinelling usually occurs at the rolling contact surfaces of the bearing races, and may be recognized by the occurrence of a series of shallow smooth indentations. The indentations have the same surface appearance as the surrounding operating area since the original surface material has not been removed but has taken a permanent set. The contour of the indentation is the same as the roller or ball radius.	True brinelling results from extremely high shock-loads which leave a permanent impression of the roller or ball in the race contact surface. Brinelling is usually caused by shock-loads when the bearing is stationary.	Evidence of true brinelling is cause for rejection.

BURNING

Description	Probable Cause	Serviceable Limits
Burning or heat failure occurs most frequently at the retainers and is also noted at the races and balls. The retainer and separators will be badly oxidized while the balls and races are softened. Accompanying high centrifugal forces may cause the metal to flow. In many instances balls may become hollow spheres.	Heat failures are caused by failure of the lubricant (cut-off of lubricant source, lubricant deterioration, or lubricant contamination), excessive loads, cramped bearings (expansion of the inner race, etc), off-square conditions causing rubbing of the retainer, and heat from an external source.	Evidence of burning is cause for rejection.

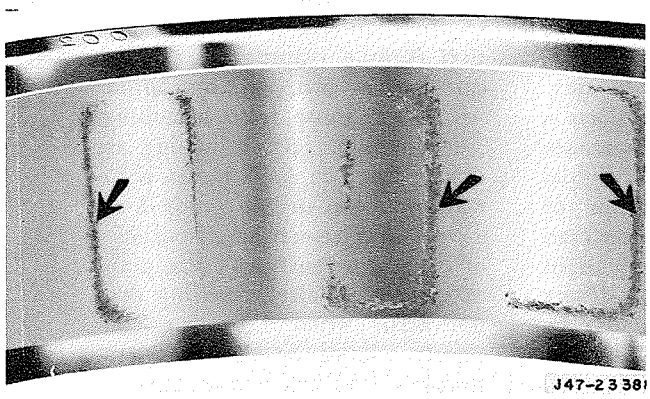


Figure 4–9. Corrosion

Description	Probable Cause	Serviceable Limits
Corrosion is an advanced stage of staining and may be recognized by shallow depressions in the original surface where the corroded area has a roughened appearance.	Corrosion frequently occurs when the bearing elements are stationary, permitting corrosive liquid to drain and form a pool at the roller contact. The greatest damage is usually at the edges of this pool. Corrosion deposits are usually slightly red.	Any corrosion which cannot be felt with bearing probe.

TABLE X. BEARING DAMAGE IDENTIFICATION AND SERVICE LIMITS (cont)

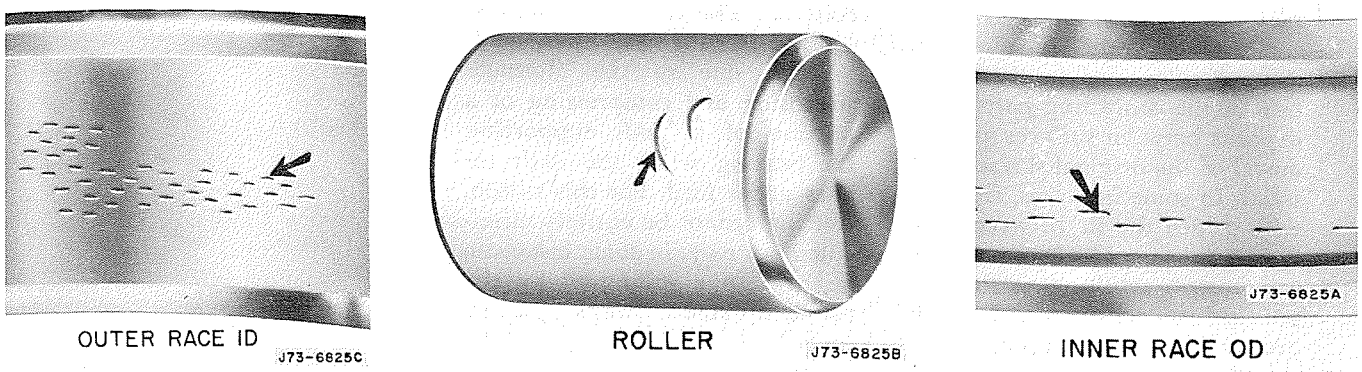


Figure 4-10. Dents

Description	Probable Cause	Serviceable Limits
Dents occur on the rolling contact surfaces of the bearing component parts and may be recognized by the occurrence of cavities with smooth sides and bottom. The cavities are depressions in the operating surface where the metal is displaced but not removed. The displaced material is thrown up as a rim about the cavity and, in many instances, the rim has a polished appearance.	Denting results from the rolling of foreign or loose material between rolling elements of the bearing. Loose material, which flattens under rolling action, falls out and leaves shallow, rounded dents. In other types, loose material causes dents more closely resembling corrosion pits but these may be distinguished by the fact that the edges are not ragged when examined under magnification.	a. Any dents which cannot be felt with bearing probe. b. On rollers of 1/2 in. diameter or less, any dents less than 0.030 in. in length which can be felt with bearing probe. c. On rollers larger than 1/2 in. diameter, any dents less than 0.060 in. in length which can be felt with bearing probe.

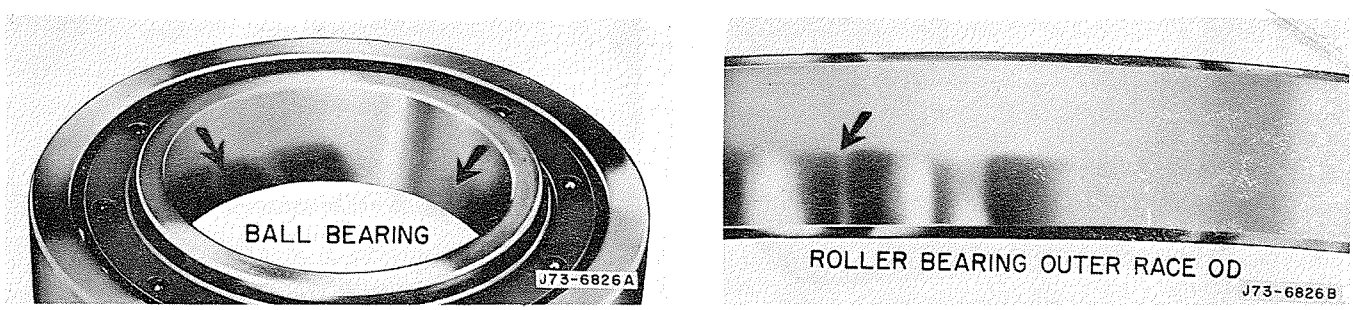


Figure 4-11. Fretting

TABLE X. BEARING DAMAGE IDENTIFICATION AND SERVICE LIMITS (cont)

Description	Probable Cause	Serviceable Limits
Fretting occurs only at surfaces in contact, where the relative motion between surfaces is extremely small (inner race and shaft, outer race and housing, ends of races and retaining members). Fretting may be recognized by discoloration of the contacting parts, rust deposits between surfaces and removal of the original surface material. In some instances, fretting will reduce the fit between surfaces until the parts become loose and rotate, resulting in highly polished contact surfaces. Rust, if present, acts as a lapping compound.	Fretting results from extremely small relative movement of two contact surfaces with resultant removal of the original surface material. The relative movement causing fretting may be as small as that due to the alternate stretching and compressing of a portion of a shaft supporting the bearing when the shaft rotates under load. For this reason, fretting cannot be entirely eliminated but may, in some instances, be held to a minimum by the use of suitable coatings of lubricants.	Any inner race bore or outer race diameter which does not have fretting on more than 20 percent of its area.

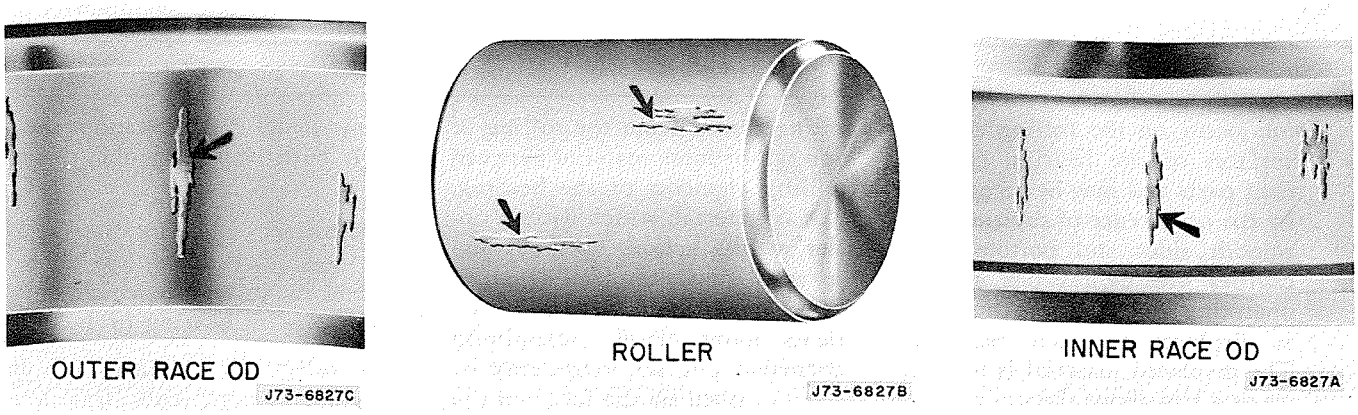


Figure 4–12. Axial Galling

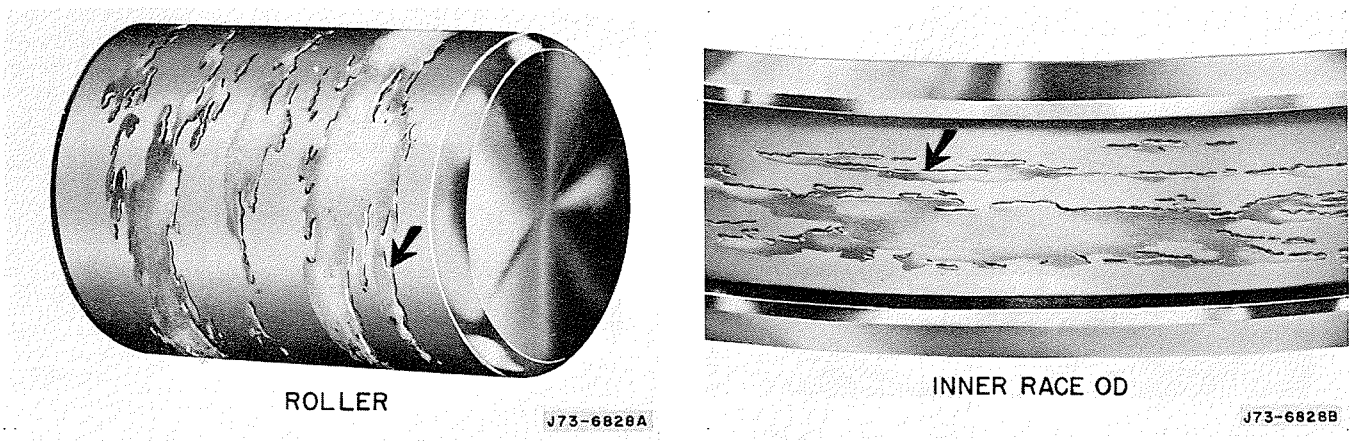


Figure 4–13. Circumferential Galling

TABLE X. BEARING DAMAGE IDENTIFICATION AND SERVICE LIMITS (cont)

Description	Probable Cause	Serviceable Limits
Galling occurs at poorly lubricated surfaces in sliding contact, and may be recognized by the presence of metal from one part remaining attached to the other.	Galling results from localized breakdown in lubrication causing friction and resultant high heat which momentarily welds the surfaces in contact. Continued motion breaks this weld, leaving portions of the weld material attached to one or both parts. Axial galling occurs when the bearing is stationary.	Galling is cause for rejection.

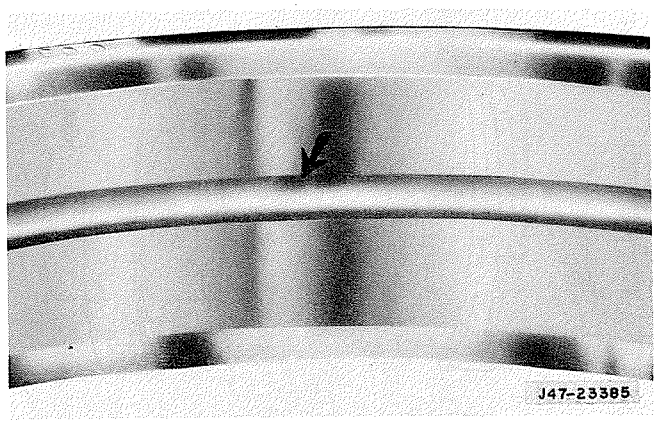
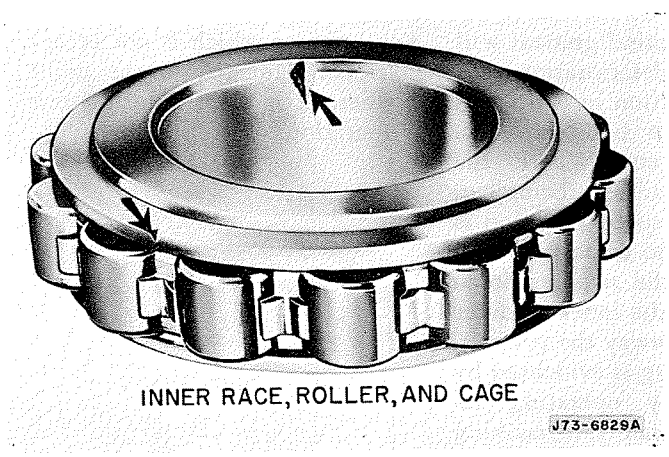


Figure 4–14. Grooves

Description	Probable Cause	Serviceable Limits
Grooves usually occur on the rolling contact surfaces of angular contact ball bearings. Inspection of the surfaces should reveal marred grooving as well as some indication of split or broken balls.	Grooving results from a thrust load applied at the bearing in the wrong direction. The ball rides on the edge of the race groove where it joins the shallow shouldered counterbore and so will break up the race surfaces.	Evidence of grooving is cause for rejection.



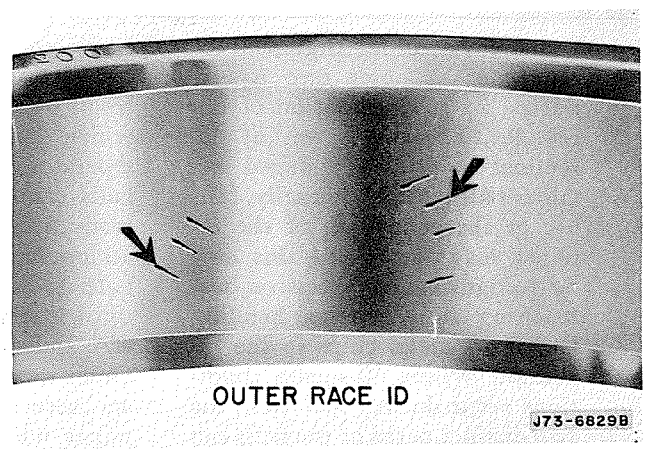


Figure 4–15. Nicks

TABLE X. BEARING DAMAGE IDENTIFICATION AND SERVICE LIMITS (cont)

Description	Probable Cause	Serviceable Limits
Nicks occur on all surfaces of a bearing which may be struck by a sharp object, and may be recognized as sharp, well defined indentations. Nicking displaces but does not remove material, with the result that the displaced material forms a ridge adjacent to the nick.	Nicking results from the bearing components striking or being struck by a hard sharp object, and therefore does not normally occur during bearing operation.	Nicks less than 0.060 in. in length that can be felt with bearing probe.

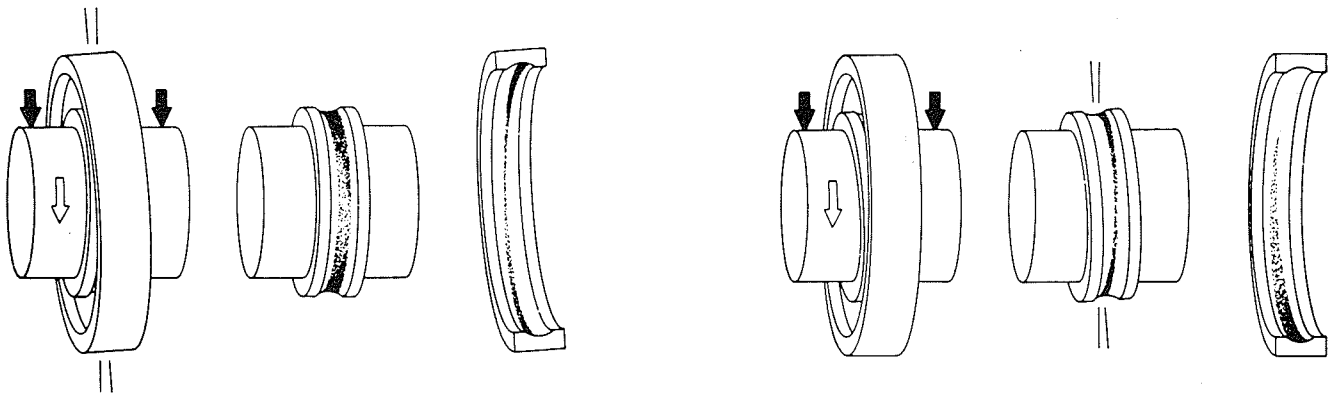


Figure 4–16. Off-Squareness and Misalignment

Description	Probable Cause	Serviceable Limits
Off-squareness or misalignment of the inner or outer race is evidenced by a deterioration of the retainer, a wearing away of the retainer bore, and gouged retainer ball pockets. Actually, failure or sharp bending of the retainer may occur, and this may be recognized by excessive heat resulting from retainer bending and small metal chips in the lubricant. Where off-square conditions occur during operation, the two distinct paths of the balls can be noted on the race.	Off-squareness or misalignment will cause retainer deterioration as a result of a variation in ball speed which jams the balls into the separator pockets. Where the balls cannot readjust themselves easily, the ball speed variation is accumulative and causes two side balls to force the retainer down until it strikes the inner or outer race and wears away the retainer. Outer race tilting is evidenced by an eccentrically operating retainer while inner race cooking causes the inner race to rotate with retainer eccentricity.	Any retainer which is not eccentric or damaged to the point where it is visible during test operation.

TABLE X. BEARING DAMAGE IDENTIFICATION AND SERVICE LIMITS (cont)

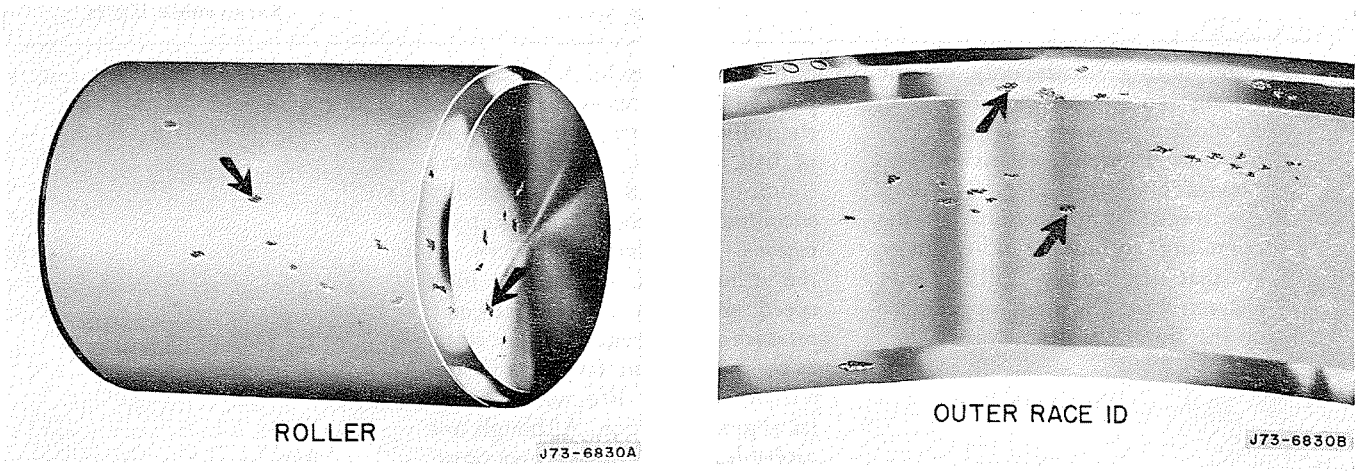


Figure 4-17. Pits-Corrosion

Description	Probable Cause	Serviceable Limits
Corrosion pitting may occur on any portion of the bearing component surface exposed to corrosive material, and may be recognized by the occurrence of extremely irregular, relatively shallow cavities in the exposed surfaces. The cavities are rough sided due to chemical action which dissolves the bearing material. Corrosion pitting has a similar appearance to fatigue pitting and denting, but may be distinguished under magnification by its shallow irregularly shaped pits with ragged edges, and the fact that usually the pits are widely distributed to include portions outside the rolling contact surfaces. In many instances, pitted areas outside the contact area have a reddish color.	Corrosion pitting results from small droplets of corrosive material, such as moisture, attacking the exposed surface of the bearing component.	a. Any corrosion pitting on rolling surfaces which cannot be felt with a bearing probe. b. Any corrosion pitting not on rolling surfaces.

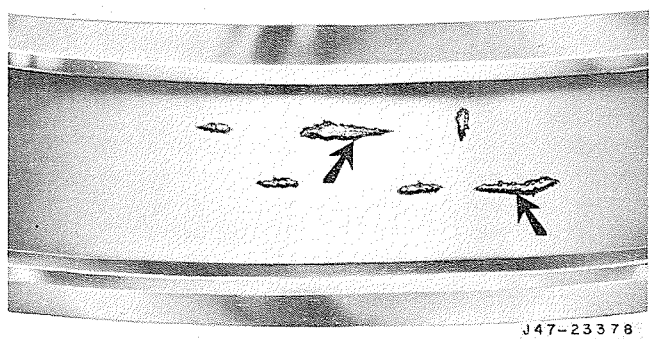
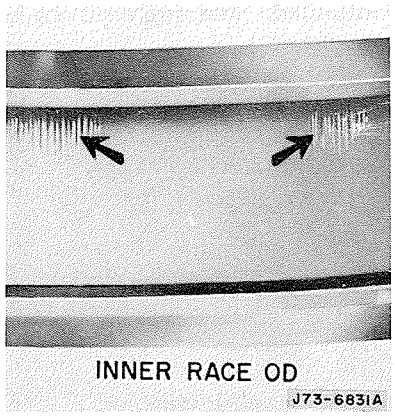


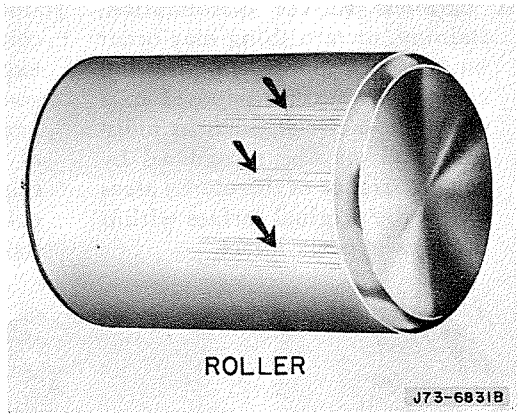
Figure 4-18. Pits-Fatigue

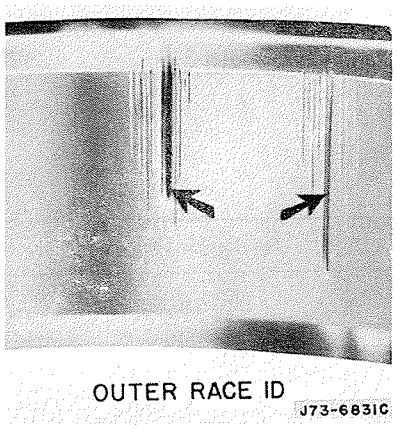
TABLE X. BEARING DAMAGE IDENTIFICATION AND SERVICE LIMITS (cont)

Description	Probable Cause	Serviceable Limits
Fatigue pitting occurs only on the rolling contact surfaces of bearing component parts, and may be recognized by irregular, relatively deep cavities in these surfaces. The cavities result from portions of the operating surface breaking away, so that the cavity will have a characteristic fractured appearance on the sides.	Fatigue pitting results from the repetitive high stresses occurring at the rolling contact area of all types of ball and roller bearings, under conditions of load and speed usually encountered in most bearing applications. Jet engine applications, on the other hand, operate at high speed and light load which may produce slippage and resultant wear. Wear rather than fatigue will determine bearing life with normal jet engine operation. Although not probable, fatigue pitting may possibly occur under normal conditions of jet engine operation when the abnormal condition provides stress concentration at the rolling contact. Misalignment which concentrates the load at the end of the rollers is an abnormal condition which should be looked for if fatigue pitting is noted, concentrated at the ends of the rollers or roller pathway.	Fatigue pitting is cause for rejection.
Scoring may be recognized by parallel or concentric grooves which penetrate the original surface of bearing components in sliding contact, or transfer from contact with scored surfaces.	Scoring results from a localized breakdown in lubrication between the sliding surfaces. Scoring may also be produced by imbedded foreign material or the deposit of hard precipitates from breakdown of the lubricant. Axial scoring occurs when the bearing is stationary such as during assembly or disassembly. Circumferential scoring (circumferential bands) extending for 360 degrees occurs during bearing operation.	a. Any scoring except as noted below which cannot be felt with bearing probe. b. On rollers, circumferential scoring (or bands) not in excess of two which can be readily felt with the bearing probe.

TABLE X. BEARING DAMAGE IDENTIFICATION AND SERVICE LIMITS (cont)







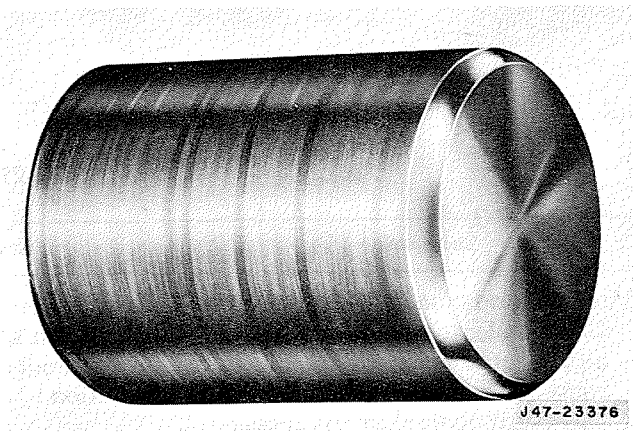
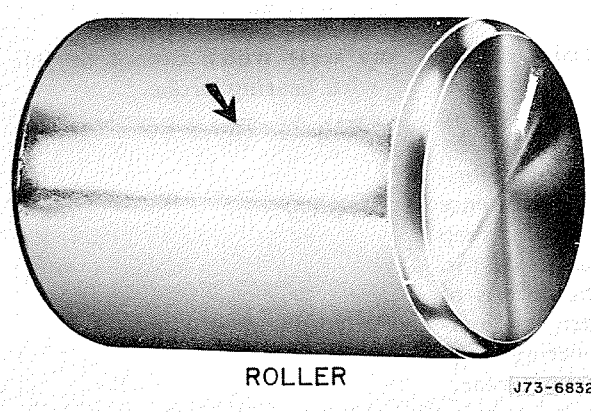


Figure 4–19. Scoring



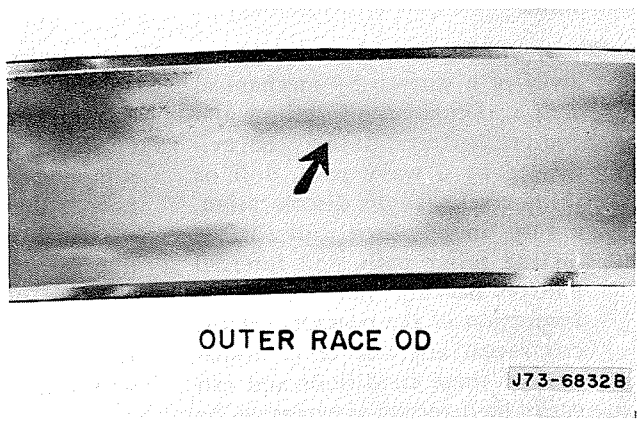


Figure 4–20. Stains

TABLE X. BEARING DAMAGE IDENTIFICATION AND SERVICE LIMITS (cont)

Description	Probable Cause	Serviceable Limits
A harmless surface discoloration, staining, or tarnishing may occur on any portion of the bearing component surface exposed to a corrosive material, such as moisture, and may be recognized by the occurrence of discolored areas where the original surface within the area appears intact.	Staining results from deposits of corrosive liquid attacking the exposed surface of the bearing component. The chemical action generally is greatest at the edge of the liquid deposit. In initial stages, the stains appear black in color; in advanced stage, the stain shows a slight red color.	Unlimited. (Staining need not be removed.)

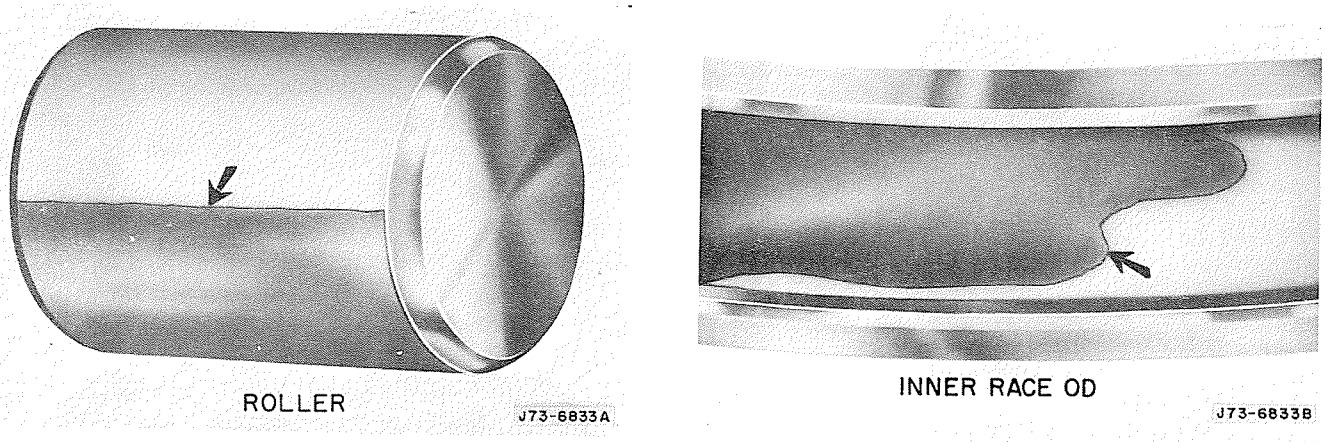


Figure 4-21. Varnishing

Description	Probable Cause	Serviceable Limits
Varnish formation, a harmless surface discoloration film, may occur on all surfaces of the bearing in contact with the lubricant and may be recognized by the appearance of the discolored film ranging from light brown to black in appearance. Commercial varnish removers will dissolve the varnish with little effect on oxide films.	Varnish formation results from breakdown of the lubricant with or without high temperature operation.	Unlimited.
Wear, which is attrition or rubbing away of a surface by mechanical action, occurs on all rolling and contact surfaces. It may be evidenced by a wavy path, dull or shiny tracks, slight discoloration, a very finely pitted dull surface on the roller path, and internal and/or bearing bore looseness. Inspection of the contact surfaces can reveal any one or combination of these conditions and can easily be detected, if excessive, by an internal looseness as well as excessive mounting play.	Wear results from abrasive matter seeping between the rolling surfaces and acting as a lapping compound. It can be caused by gummed or insufficient lubricant, vibration in the presence of abrasive particles, or creep due to a loose mounting or pit. Varying off-square conditions of the inner or outer race and inertia forces on the bearing cage will also cause excessive wear.	Any wear which cannot be felt with bearing probe.

4–65. BEARING HOUSINGS AND SPACERS.

4–66. INSPECTION.

a. Inspect housings for nicks, dents, burrs and scarfing. Remove high metal with Arkansas stone or fine file.

b. Inspect housing contacting surfaces for mutilations and distortions. Replace housing if so damaged.

c. When a visual inspection indicates that a dimensional inspection is necessary, perform such an inspection in accordance with the limits in table XI.

d. Accept no cracks in bearing housings or spacers.

TABLE XI. DIMENSIONAL INSPECTION OF BEARING COMPONENTS

Note

All reference numbers in this section refer to Section VIII.

*Part No.	Nomenclature	Reference No.
8992327	Compressor Rear Frame Bearing Housing ID	19
8992327	Compressor Rear Frame Bearing Housing OD	18
8992327	Compressor Rear Frame Bearing Housing Outer Flange OD	16
8986587	No. 3 Bearing Housing ID	62
8481929	No. 4 Bearing Housing ID	56
8481929	No. 4 Bearing Housing OD	59
8481929	No. 4 Bearing Aft Rabbet OD	53

*Use part number or superseding part number.

4–67. REPAIR.

a. Remove high metal with Arkansas stone or fine file.

b. Remove aluminum seal pick-up with a caustic soda solution using one pound of commercial type caustic soda per gallon of water. Temperature of solution should be 82°C (180°F). Submerge the part in solution for a period of 2 to 3 minutes. Rinse with cold water.

4–68. AIR AND OIL SEALS (LABYRINTH TYPE).

4–69. INSPECTION.

a. Inspect inner and outer air and oil seal serrations for damage. Replace seals having damage exceeding the following limitations unless otherwise indicated.

(1) Accept any number of minor nicks, dents or scores up to a maximum of 1/64 inch in depth if only the removal of high metal is necessary. Rework any number of nicks, dents or scores exceeding this limit if the rework area does not exceed one inch in length and 1/8 inch in depth.

(2) Accept any number of repairs on serrations if there is a sealing area or equivalent area of at least 3 undamaged serrations excluding minor nicks, dents or scores up to 1/64 inch.

Note

One serration, first or last only, may be completely removed from a seal if there are at least 3 undamaged serrations remaining.

(3) Rework all cracks in serrations if the rework areas do not exceed one inch in length and 1/8 inch in depth.

(4) If seals are within serviceable limits, accept displaced metal caused by the rubbing of serrations. Remove any flaking or peeling of displaced metal.

b. Inspect the aft air and oil seal surfaces for cracks in the air exit ports. Rework cracks up to 1/4 inch in length and 1/16 inch in depth. Replace seals having cracks exceeding these limits.

c. Inspect air and oil seals for bent, torn or excessively nicked serrations. Straighten bent serrations. Straighten and blend sharp corners of torn and excessively nicked serrations.

d. When a visual inspection indicates a need, perform a dimensional inspection. See table XII for air and oil seals serviceable limits.

4–70. REPAIR.

a. Remove high metal from minor nicks, dents or scores by blending with a fine file and/or stone.

b. Grind out cracks in the aft air and oil seal air exit port with a rotary file, portable grinder or by some suitable method and blend.

c. Straighten bent, torn or excessively nicked serrations, and if necessary, blend sharp corners.

Note

If straightened serrations or portions of serrations found between two damaged areas present a weakness in the tooth structure, remove the weakened area and blend.

4–71. INSPECTION AND REPAIR OF AUXILIARY DRIVE SECTION.

4–72. ALTERNATOR MOUNT ASSEMBLY.

4–73. INSPECTION AND REPAIR.

a. Inspect the alternator mount for cracks, nicks, dents and scratches as follows:

(1) Accept nicks or scratches on the body, if they do not exceed 1/16 inch in depth and 1-1/2 inches in length after blending.

(2) Accept nicks, scratches, and other minor damage, across the width of the flange face if they do not exceed 1/16 inch in depth.

(3) Accept, after removal of high metal, nicks and dents in the struts.

(4) Cracks and breaks in the mount are not repairable at field maintenance level. Remove and replace any mounts with cracks or breaks in the casing. Cracks in the strut web are acceptable if they can be blended to a smooth contour without exceeding a maximum depth of 3/8 inch. Replace the mount if depth of crack area after rework exceeds 3/8 inch, or if more than one

TABLE XII. DIMENSIONAL INSPECTION OF AIR AND OIL SEALS

(All references in this table refer to Section VIII, Table of Limits)

Part No.	Nomenclature	Reference No.
9482029 124D810	Compressor Rear Frame Outer Air Seal ID	9
9482029 124D810	Compressor Rear Frame Outer Air Seal Rabbet ID	11
9482029 124D810	Compressor Rear Frame Outer Air Seal Inner Shelf OD	14
9482029 124D810	Compressor Rear Frame Outer Air Seal Rabbet OD	13
8992854 124D811	Compressor Rear Frame Inner Air Seal OD	12
8992854 124D811	Compressor Rear Frame Inner Air Seal ID	13
8481928 9493713	Turbine Frame Air Seal ID	52
8481928 9493713	Turbine Frame Oil Seal ID	55
8992663	Front Frame Oil Seal Hub ID	32
8992663	Bearing Oil Seal Shelf OD	30
8992663	Bearing Oil Seal Hub OD	31
9451588	No. 2 Bearing Cap Rabbet Housing ID	16
9451588	No. 2 Bearing Outer Oil Seal Cover Rabbet ID	17
9451588	No. 2 Bearing Inner Oil Seal ID	29
8986734	No. 2 Bearing Outer Oil Seal ID	28
8986734	No. 2 Bearing Oil Seal Cover Deflector OD	20
8986734	No. 2 Bearing Outer Oil Seal Cover Rabbet OD	17
9493009–1	Compressor Front Frame Rear Inner Seal ID	31
9493009–1	Compressor Front Frame Rear Inner Seal ID	30
8986422	Twelfth Stage Deflector Oil Seal ID	27
8986422	Twelfth Stage Deflector Oil Seal Shelf OD	29
8986422	Twelfth Stage Deflector Oil Seal Shelf ID	20

crack exists on a strut.

b. Inspect splined nuts for looseness or damage. Replace any loose or damaged splined nut.

c. Inspect tapped holes for damaged threads or damaged helical inserts. Replace damaged helical inserts as follows: (Refer to Table XIII for correct helical insert tools)

(1) Remove damaged helical inserts with extractor.

(2) Inspect hole and threads.

(3) Install new helical insert using prewinder and break-off tool.

Note

Several drops of oil on the helical insert will aid installation.

(4) Rework all scratches or damage to the surface around the hole.

(5) Touch-up the repaired area with dichromate, zinc chromate, or equivalent protective paint.

d. Inspect all screw bushings (threaded inserts) for secure pin locking and damage to pins or bushings. Lock, replace, or repair screw bushings which are loose or damaged as follows:

(1) Remove damaged locking pins and replace them with new pins.

(2) Remove and replace loose screw bushings that cannot be repaired by using a new locking pin.

Note

All screw bushings (threaded inserts) have 5 pitch diameter classifications or sizes, each identified by an individual color. (See Section VIII, Table XLVII). Select the proper size so that the bushing will have a definite interference fit when assembled in the mating tapped hole, before the locking pin is installed. Avoid an excess interference fit that would damage the parent part.

(3) If threaded holes on the mount are damaged or cracked to such an extent that maximum allowable oversize screw bushings cannot be installed, replace the mount.

(4) Inspect the three jacking plates for looseness. If the plates are loose, secure by restaking. Replace missing plates and secure by staking.

e. Inspect the alternator mount bearing housing assembly for nicks, scratches, cracks or breaks in the casing. Minor nicks or scratches on the outside of the casing may be repaired by blending. Replace housing assembly if cracks or breaks are found. If the housing assembly shows evidence of oil leakage, binding or looseness, remove and replace assembly.

Note

Alternator drive bearing housing assemblies are not to be disassembled by field maintenance activities. Return unserviceable assemblies to overhaul activity for repair.

4–74. HYDRAULIC PUMP DRIVE CASING AND COVER.

4–75. INSPECTION.

a. Inspect the casing and cover for cracks or breaks as follows (figure 4–22):

TABLE XIII. TOOL CHART FOR HELICAL INSERTS

Heli-Coil	Thread Size	Drill Hole	Drill Size	Extractor	Break-Off Tool
1185–3	10–24–NC	0.199–0.205	13/64	1227–6	1195–3
1185–4	./4–20–NC	0.261–0.267	G	1227–6	1195–4
1185–5	5/16–18–NC	0.328–0.334	21/64	1227–6	1195–5
1185–6	3/8–16–NC	0.390–0.398	25/64	1227–6	1195–6
1185–7	7/16–14–NC	0.453–0.463	29/64	1227–16	1195–7
1185–8	1/2–13–NC	0.515–0.525	33/64	1227–16	1195–8
1185–9	9/16–12–NC	0.578–0.588	37/64	1227–16	1195–9
1185–10	5/8–11–NC	0.653–0.663	21/32	1227–16	1195–10
1185–12	3/4–10–NC	0.781–0.791	25/32	1227–16	1195–12
1191–3	10–32–NF	0.196–0.202	No. 8	1227–6	1196–3
1191–4	1/4–28–NF	0.257–0.264	F	1227–6	1196–4
1191–5	5/16–24–NF	0.323–0.330	21/64	1227–6	1196–5
1191–6	3/8–24–NF	0.386–0.392	25/64	1227–6	1196–6
1191–7	7/16–20–NF	0.450–0.458	29/64	1227–16	1196–7
1191–8	1/2–20–NF	0.513–0.522	33/64	1227–16	1196–8
1191–9	9/16–18–NF	0.577–0.586	37/64	1227–16	1196–9
1191–10	5/8–18–NF	0.640–0.649	41/64	1227–16	1196–10
1191–12	3/4–16–NF	0.765–0.775	49/64	1227–16	1196–12

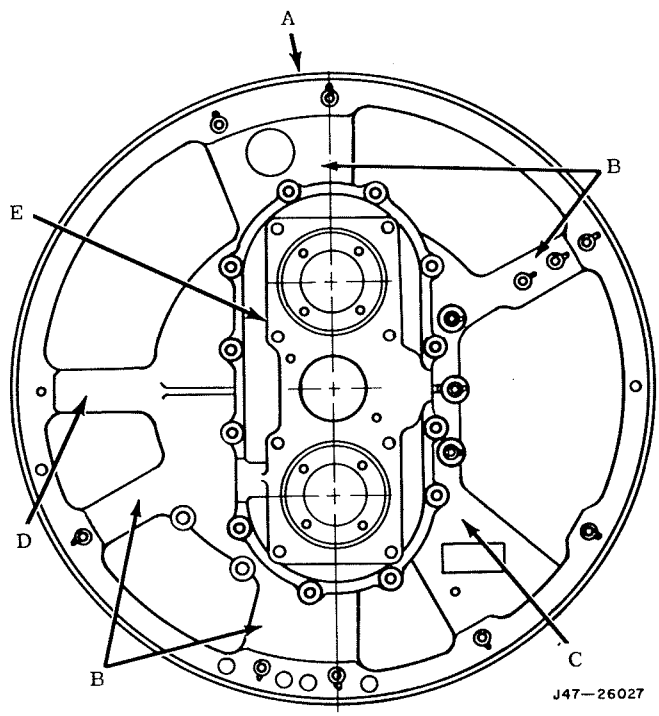


Figure 4–22. Repair Areas, Hydraulic Pump Drive Casing

Note

If cracks or breaks are beyond repairable limits, replace the hydraulic pump drive assembly.

(1) No cracks in the casing body (Area A) or cover (Area E) are allowable.

(2) Accept cracks in the strut webs at the 12, 2, 6 and 8 o'clock positions (Area B), if they can be ground out and blended to a smooth contour without exceeding a maximum depth of 1/2 inch. Only one crack per web is allowable.

(3) Accept one crack in the strut web at the 5 o'clock position (Area C) if it can be ground out and blended to a smooth contour without exceeding a maximum depth of 1/4 inch.

(4) Accept one crack in the strut web at the 9 o'clock position (Area D) if it can be ground out and blended to a smooth contour without exceeding a maximum depth of 3/8 inch.

(5) Accept, after blending, breaks in the bullet nose mounting flange if they are no longer than 1-1/4 inches and not closer than one inch to a mounting hole. Three breaks per casing are permitted.

b. Inspect all screw bushings (threaded inserts) for secure pin locking and damage to pins or bushings.

c. Inspect studs for looseness and damage to threads, or bent studs.

4–76. REPAIR.

a. Repair cracks described in paragraph 4–75a, by blending to a smooth contour.

CAUTION

Use extreme care to prevent metal particles from falling into the hydraulic pump drive assembly and air inlets. Do not disassemble the drive assembly to make repairs. If cracks are not accessible for blend repair, replace the assembly.

b. Hand repair any nicks, burrs or high metal with emery cloth, a fine file, or Arkansas stone. Touch-up repaired areas with zinc chromate, dichromate, or equivalent protective paint.

c. Replace loose or damaged studs with new studs selected to meet the required torque.

Note

Hydraulic pump drive studs have 5 pitch diameter classifications or sizes, each identified by an individual color. (See Section VIII, Table XLV). Select the proper size so that the stud will meet the torque requirements when installed in the mating tapped hole. Use zinc chromate primer on the stud threads before installing.

d. Properly lock or replace screw bushings (threaded inserts) that are loose or have damaged threads.

Note

All screw bushings have 5 pitch diameter classifications or sizes, each identified by an individual color. (See Section VIII, Table XLVII). Select the proper size so that the bushing will have a definite interference fit when assembled in the mating tapped hole, before the locking pin is installed. Avoid an excessive interference fit that would damage the parent part.

4–77. INSPECTION AND REPAIR OF AIR INLET SECTION.

4–78. ACCESSORY COWL ASSEMBLY.

4–79. INSPECTION AND REPAIR.

a. Inspect the accessory cowl assembly for cracks, nicks, dents, and chafing.

(1) Accept, after repair, cracks in the outer skin.

(2) Replace cowl assemblies having cracks in the stringers.

(3) Accept dents not exceeding 1/8 inch in depth, 3/8 inch in diameter and located more than one inch apart. Repair dents exceeding these limits.

(4) Accept, after removal of high metal, nicks not exceeding 1/4 the metal thickness. Repair nicks exceeding these limits.

(5) Accept chafing damage which does not exceed 1/3 the metal thickness and which is less than 2-1/2 inches in diameter after blending to contour of surrounding material.

b. Inspect the cowl assembly for loose, damaged, or missing rivets. Replace loose, damaged, or missing rivets. Replacement rivets may be one size larger than the original.

c. Repair dents, cracks and chafing to the outer skin as follows:

(1) Dents exceeding allowable limits should be re-formed to the original contour as much as possible.

(2) "V" groove and stop drill all cracks and welds, using the inert arc process. No welding is permitted on or over the cowl stringers.

(3) Nicks and chafing exceeding allowable limits should be filled with weld, then blended to the original contour.

(4) Replace loose, damaged, or missing rivets. Replacement rivets may be one size larger than the original.

d. After rework, touch up any damage to the protective finish with zinc chromate, or equivalent protective paint.

4–80. AIR INLET SCREENS AND SCREEN BEARINGS.

4–81. INSPECTION.

a. Inspect the air inlet screens for cracks, nicks and dents, and for bent or broken rods.

b. Inspect the screens for binding or excessive play. If either is evident, remove the screen and check the bearings and the bearing surface of the trunnions. If

the bearing surface of the trunnion is less than 0.3100 inch, replace the screen assembly.

c. Inspect the inlet screen bearings and bearing housing for cracks, nicks, helical insert damage, and defective bearings.

(1) Replace inlet screen bearing having cracks in the housing or bearing.

(2) Replace damaged helical inserts.

(3) Minor nicks and scratches on the bearing housing are acceptable after removal of high metal.

(4) Inspect inlet screen bearings for axial play. Replace bearings having over 0.015 inch axial play.

4-82. REPAIR.

a. Repair cracked supports, gussets or cowls by "V" grooving the crack and welding by the metal arc process, using AWS E6010 rod (B21B10) or equivalent. Repair cracked joints by grinding out the cracked material and re-brazing.

Note

Air inlet screens will not require refinishing because of black deposit on silver solder. Silver solder needs no protective finish.

b. Replace damaged ribs as follows:

(1) Strip the protective finish from the air inlet screen assembly.

WARNING

It is important that the cadmium plating be removed from the air inlet screen assembly prior to heating it with a torch. Burning of cadmium with a torch leaves an undersirable residue and fumes from the burning cadmium may be injurious to the health of personnel.

(2) Cut through the damaged rib flush with the inner side of the 2 outside struts.

(3) Place the air inlet screen upside down on the welding table so that the bottom side of the struts is exposed.

(4) Use a small welding torch (00 tip, or equivalent) and direct the flame against the strut adjacent to but not directly on the base of the damaged rib. When the strut is heated, use a notched steel rod and press downward against bottom edge of the damaged rib. The rib should slip out of the notch in the strut.

(5) To remove end portions of the ribs, heat the strut around the rib at one end. Do not let the flame come in contact with the rib. When the strut is heated, use pliers to remove the rib from the strut.

(6) Remove all damaged ribs in the manner described above.

(7) Use a file or torch and wire brush to remove all residue from the rib slots and sides of struts.

(8) Install new rib in position in the struts.

(9) Turn the air inlet screen assembly upside down on the welding table and braze the new rib to each strut with silver solder. To braze the new rib to each of the outside struts, hold the inlet screen in the vertical position.

Note

Solder must completely penetrate the joints and surround them to the required depth.

(10) After brazing new rib, wait for color loss, then dip in water to remove excess flux.

(11) Use motor and fine wire rotary brush to remove remaining flux.

(12) Cut off ends of newly installed rib.

(13) When all the damaged ribs have been replaced, clean the unit thoroughly and replate with cadmium in accordance with Federal Specification QQ-P-416 or paint with heresite paint P-413 (Heresite and Chemical Company, Manitowoc, Wisconsin) or equivalent.

c. Re-braze loose clevis pins on the air inlet screen assembly.

d. Accept screens with nicks and burrs after removal of high metal with a suitable file.

e. Replate screens needing a protective finish in accordance with Federal Specification QQ-P-416 or paint with heresite paint, P-413 (Heresite and Chemical Company, Manitowoc, Wisconsin) or equivalent.

f. Repair inlet screen bearing housing assemblies as follows:

(1) Remove high metal surrounding scratches, scores, nicks and burrs on bearing housing. Replace bearing housing having cracks.

(2) Replace damaged helical inserts in screen bearing housings. If threads in tapped hole are damaged, re-bore and tap to receive a bushing screw. Tapped holes must maintain a 0.060 inch minimum wall thickness.

(3) Replace inlet screen bearings exceeding 0.015 inch axial play.

(4) After rework, wash bearing housing assembly in solvent, Federal Specification P-S-661b, and soak in oil, Specification MIL-O-6081, for 30 minutes.

4-83. AIR INLET FAIRINGS.

4-84. INSPECTION AND REPAIR.

a. Inspect fairings for nicks, scores, dents and cracks.

(1) Accept, after removal of high metal, nicks and scores not exceeding 1/64 inch. Replace fairings when nicks and scores exceed this limit.

(2) Accept dents in the forward section of the fairing (leading edge to air slots at overlap) provided they do not exceed 1/4 inch in diameter or 3/32 inch in height or depth, are spaced at least one inch apart and there are no more than 5 dents per fairing. Replace the fairing if these limits are exceeded. Accept, after rework, dents in the aft section (air slots to trailing edge).

(3) Replace the fairing when there are cracks in the forward section of the fairing. Cracks in the aft

section may be repaired by "V" grooving, stop drilling, and welding.

b. Inspect the de-icing connection for thread damage and cracks.

(1) Replace fairings having cracked de-icing connectors.

(2) Repair damaged threads using a thread chaser, if no more than one full entrance thread is damaged. If thread damage exceeds this limit, replace the fairing.

Note

When reworking threads plug or block the air passage in the connector to prevent metal chips from accumulating in the air tube.

CAUTION

After rework of thread damage, remove plug from connector air passage.

c. Inspect the fairings for broken or cracked welds. Repair all broken or cracked welds by "V" grooving and rewelding. Defective spot welds may be repaired by drilling a 3/32 inch hole through the defective weld and filling with weld by the inert arc process. After welding, blend to original contour.

d. Inspect the fairing assembly for defective or loose camlock fasteners. Grommets can be either free to turn or tight in the dimple. Inspect the camlock stud for loose, damaged or broken crosspins. Replace any defective fasteners. If the area around the fastener is worn thin (0.030 inch minimum), remove the fastener and build up the area with weld.

e. Remove any camlock studs, P/N 4022–4, and replace with camlock studs, P/N 4022–5. Reidentify island fairing, P/N 126C161, with P/N 127C708 after replacing studs.

f. Touch up all repaired areas with zinc chromate or equivalent protective paint.

4–85. AIR INLET DUCT SECTORS.

4–86. INSPECTION AND REPAIR.

a. Inspect the air inlet duct sectors for nicks, dents, and cracks.

(1) Repair cracks in the air inlet sector assemblies. Accept without repair, one crack per Camloc fastener extending from Camloc fastener rivet hole into the Camloc bolt hole.

(2) Accept, after removal of high metal, nicks not exceeding 1/4 the metal thickness.

(3) Accept dents not exceeding 1/2 inch in diameter or 3/32 inch in depth, provided they are not located in an area that would interfere with assembly of the part. Re-form dents to the original contour in areas that interfere with assembly.

b. Rework distorted mounting flanges if they contain no circumferential bends. If there are circumferential bends, replace the sector assembly.

c. Replace defective rivets, nut plates, and camlock fasteners.

d. Inspect sector assemblies, part numbers 122D246, 122D313, 122D317, and 508E462, for rivets securing the support bracket to the sector assembly. Rework assemblies listed above which do not have the riveted support bracket as follows: (See figure 4–23.)

(1) Locate and drill 4 holes 0.094 inches in diameter and countersink the holes in the bracket as shown in figure 4–23.

(2) Insert 2 aluminum alloy rivets, P/N AN426-AD3–8, with countersunk head in the forward flange holes and 2 rivets, P/N AN426AD3–5, in the side holes.

(3) Install the rivets from the outside of the air inlet sector.

(4) Upset the rivets on the inside of sector.

(5) After riveting, file any protruding rivet heads flush with the sector surface.

e. Blend chafing damage that does not exceed 1/3 the metal thickness or 2 inches in diameter. If chafing damage exceeds these limits, fill with weld and bench to original contour.

f. Repair cracked spot welds on the sector assembly by drilling a 3/32 inch hole through the cracked weld and filling with weld. "V" groove any cracks in the sectors and weld. After welding, bench to original contour.

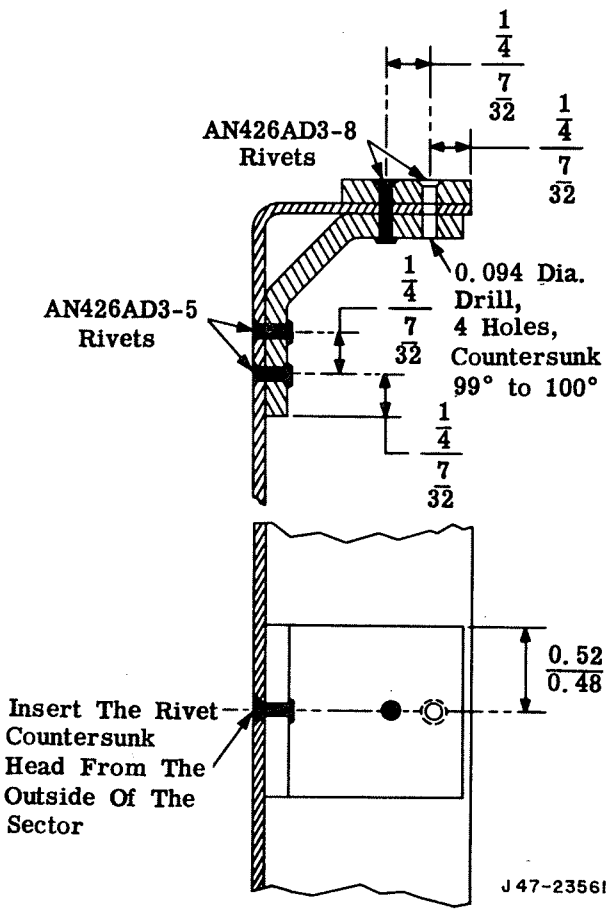


Figure 4–23. Rework of Air Inlet Sectors

g. Inspect sectors repaired by welding by red dye-penetrant method.

4–86A. AIR INLET FILLERS.

4–86B. INSPECTION AND REPAIR.

a. Inspect the air inlet fillers for nicks, gouges, dents, and cracks.

(1) Accept, after removal of high metal, nicks and gouges not exceeding 1/2 the metal thickness.

(2) Accept dents not exceeding one inch in diameter and/or 1/4 inch in depth provided they are not located in an area that would interfere with assembly. Re-form dents that exceed above limits, or if located in areas that interfere with assembly, to as near as possible to the original contour.

(3) Stop drill, V-groove and weld cracks and bench to original contour. Inspect weld, using red dye-penetrant method.

b. Inspect and replace damaged or missing nut sectors.

4–87. ISLAND COVERS.

4–88. INSPECTION AND REPAIR.

a. Inspect the island covers for nicks, dents, cracks, damaged brackets, and missing or defective fasteners, nut plates, and rivets.

(1) Remove high metal around nicks and scratches which are less than 1-1/2 inches long and 0.010 inch in depth. Weld, or use silver solder to braze nicks and scratches in excess of these limits.

Note

Repair weld on the island covers using the inert arc or metallic arc process. Strip the cadmium plating from the area to be welded prior to welding.

(2) Re-form to original contour dents in excess of 1/64 inch. Accept dents less than 1/64 inch in depth.

(3) Repair cracks in the covers by welding, using the inert arc or metallic arc process.

(4) Replace missing or defective fasteners, nut plates, and rivets. Replacement rivets may be one size larger than the original.

(5) Repair or replace broken or cracked brackets.

b. Island covers should be cadmium plated following weld repair. If plating facilities are not available, touch-up the repaired areas with zinc chromate or equivalent protective paint.

4–89. ANTI-ICING DUCT ASSEMBLIES.

4–90. INSPECTION AND REPAIR.

a. Inspect the duct assemblies for nicks, dents, and cracks.

(1) Replace cracked duct assemblies.

(2) Accept nicks less than 1/10 of the metal thickness after removal of high metal. Fill nicks in excess of 1/10 the metal thickness with weld and bench to original contour.

(3) Accept dents in the anti-icing duct assemblies not exceeding 3/32 inch in depth regardless of the location. Rework dents exceeding these limits to as near as possible the original contour. Replace ducts that cannot be reworked to conform to these dimensions.

b. Inspect the duct assemblies for holes in the embossed (bubble) area. Repair holes in this area by welding a patch over the raised area and blending to a smooth contour. Use a locally manufactured patch from AMS 4015 or AMS 4025 material.

c. Inspect the duct assembly for damaged or missing rivets. Replace damaged or missing rivets securing lug to duct assembly with new rivets, P/N AN470DD3–5.

d. Inspect the duct assembly for cracked braze securing retaining pin. Repair by rebrazing the cracked areas.

e. Inspect the lugs for distortion and wear. Straighten distorted lugs on the duct assembly. If holes are oversize, fill with weld, and bench to original contour. Drill a 0.168 to 0.178 diameter hole and countersink to 99–101 degrees x 0.35–0.37 inch diameter.

4–91. INSPECTION AND REPAIR OF COMPRESSOR SECTION.

4–92. COMPRESSOR FRONT FRAME.

4–93. INSPECTION AND REPAIR.

a. Inspect the compressor front frame for cracks, nicks or scratches. If there is damage in excess of repairable limits, replace the compressor front frame assembly, if authorized by the command, and return it to an overhaul activity. If replacement is not authorized, return the engine to an overhaul activity.

b. Inspect the compressor front frame for loose bushings and damaged bushing threads. Replace, repair, or properly lock bushings that are loose or have damaged threads. Replace damaged locking pins with new pins. Repair loose bushings that cannot be repaired with new locking pins as follows:

(1) Drill out the old locking pin and remove the bushing.

(2) Inspect the hole and threads; then determine the size (OD) of the replacement bushing. Use the next size bushing if necessary, but take care to allow a minimum wall thickness of 0.060 inch and in interference fit.

Note

For the assembly of screw bushings (threaded inserts) refer to paragraph 8–28. To determine the proper insert, refer to table XLVII.

(3) Re-drill and tap to specified size.

(4) Dichromate the repaired area if facilities are available.

(5) Insert the selected bushing, with its external threads coated with zinc chromate primer, to 0.005 to 0.030 inch below the surface.

(6) Drill the lockpin hole and pin the bushing in place.

(7) Clean and inspect.

c. Inspect the compressor front frame for damaged helical inserts. If facilities are available, replace damaged helical inserts as follows: (Refer to table XIII for correct helical insert tools.)

(1) Remove damaged helical insert with extractor.

(2) Inspect hole and threads.

(3) Dichromate the repaired area.

(4) Install new helical insert using prewinder and break-off tool.

Note

Several drops of oil on the helical insert will aid the installation.

(5) Rework all scratches or damage to the surface around the hole.

(6) Repeat dichromate if necessary.

(7) If the threads in the casting have been damaged beyond repair, replace the helical insert with a thread bushing. For instructions, refer to paragraph 4-93 "b".

d. Inspect the compressor forward frame anti-icing port holes for cracks. Repair as follows:

(1) Remove cracks in the anti-icing port holes by local blending, provided the cracks do not extend below counterbore. Replace the front frame assembly (refer to paragraph 4-93 "a") if the cracks extend below the counterbore.

(2) Chamfer 1/16 inch and blend the anti-icing port hole in the 3, 6, 9, and 12 o'clock struts.

(3) Clean the anti-icing port holes by etching lightly with 3% hydrofluoric acid or by some other suitable method.

(4) Dichromate the repaired area if facilities are available.

e. Inspect the compressor front frame magnetic plug receptacle for damage. Replace damaged plug. Repair damaged threads in the tapped holes of the front frame as follows:

(1) Drill and tap the receptacle for a 3/8 inch aluminum pipe plug, AN913-3D.

(2) Dichromate threads in the front frame and alodine or anodize threads on the pipe plug if facilities are available.

(3) Install the plug.

(4) Stake the plug with one aluminum pin (1/8 inch diameter by 1/4 inch length).

(5) Face the plug to regain the original front frame configuration and check for leakage.

(6) Drill and tap plug to specification.

(7) Drill new lockwire holes when damage appears excessive.

f. Inspect the compressor front frame for cracks or breaks. Rework cracks and breaks within limitations.

(1) Accept damage to the compressor case pilot rabbet (figure 4-24) after blending rough edges, provided that not more than 2-1/2 inches in any one location is broken out and not more than 3 breaks exist in the full circumference. There must be at least 6 inches of unaffected material between breaks. This inspection is not necessary unless the compressor front frame is disassembled from engine. Replace compressor front frame (refer to paragraph 4-93 "a") if these limits are exceeded.

(2) Accept mounting flange bolt hole cracks which extend to the outside edge of the mounting flange, provided no more than 3 holes on each mounting flange are cracked and at least 3 unaffected bolt holes remain between cracks. Replace compressor front frame (refer to paragraph 4-93 "a") if these limits are exceeded, or if cracks or breaks other than those outlined in paragraphs 4-93, "d" and 4-93, "f" are present.

g. Inspect compressor front frames for nicks, scores or scratches. Accept such damage after removal of high metal, provided the depth of damage will not cause a breaking out of a flange.

h. Perform hand repair to remove high metal with emery cloth, a fine file, or an Arkansas Stone. Touch up repaired areas with dichromate.

i. Inspect male splines on accessories and female splines in shaftgear drives for wear. Accept spline

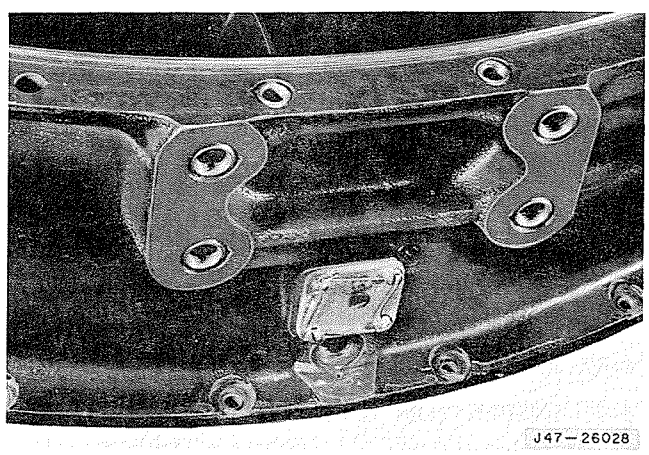


Figure 4-24. Compressor Front Frame Pilot Rabbet

wear not exceeding 1/3 the original tooth thickness. Spline wear exceeding this limit is cause for rejection. Remove accessories for inspection of splines as follows:

Note

These are special instructions for removal of accessories to prevent complete disassembly of each accessory as outlined in paragraph 3-55. As each accessory is removed, inspect the male splines on the accessory and female splines in shaftgear drive for wear. Except for the fuel pump, replace accessory if male spline is worn beyond limit, replace the fuel pump shaft. If female spline in any shaftgear in J47-23/-27 engine is worn beyond limit, reject the engine. If female spline in any shaftgear in J47-25/-25A engine is worn beyond limit, replace the front frame assembly. (Refer to paragraph 3-46.)

(1) Remove the auxiliary drive gearcase in accordance with instructions in paragraph 3-24.

(2) Disconnect the starter-generator leads and remove the starter-generator and collar base by loosening the Marman clamp; lift positioning lock, then twist starter to other cut-out in the collar base and remove the starter-generator, collar base, gasket, and adapter spline.

(3) Remove the fuel regulator lube oil filter and orifice by disconnecting hoses at the regulator and gearbox. Cap and plug all openings.

(4) Disconnect the two -4 fuel drain hoses from the T-connection at base of fuel pump, the two -4 fuel hoses (VCO in and VCO return) at fuel control valve, the -12 fuel hose (between stopcock and control valve) at the stopcock, the main fuel in hose at No. 3 island; then, remove the fuel pump, fuel control valve, and fuel filter as a unit. Cap and plug all openings.

(5) Disconnect the control linkage to the stopcock and regulator (either end), the -4 CDP hose at regulator, the -4 VCO return hose at gear case, the -12 main fuel hose (between stopcock and No. 3 island) at the stopcock; then, remove the regulator and stopcock as a unit. Cap and plug all openings.

(6) Disconnect tachometer lead, the oil hoses to the lube pump at the gearcase and No. 2 and No. 3 island; then, remove the lube pump and tachometer as a unit. Cap and plug all openings.

(7) Disconnect hydraulic hoses at the hydraulic pump (if hydraulic pump is installed) and remove the pump.

Note

If the front frame requires replacement due to spline wear (or other reasons) and will not be reinstalled, proceed with provisions of subparagraphs (8) and (9). If the front frame is being removed to correct a deficiency and will be reinstalled, the instructions in subparagraphs (8) and (9) may be omitted.

(8) Remove the accessory cowl supports, the control shaft inner bearing, and all hoses connected to the front frame cover. Cap and plug all openings.

(9) Remove the nuts and bolts securing the air inlet sectors and island to the front frame, and remove the air inlet sectors and islands as a unit. The air inlet sectors, fillers, and islands need not be disassembled unless necessary to accomplish repair.

Note

For front frame removal and installation instructions, refer to paragraphs 3-46 and 6-15.

(10) After all inspection and repair has been accomplished, install the accessories and air inlet section components to the compressor front frame in reverse order of removal, using the instructions in paragraphs 5-7 through 5-17. Since the accessories and possibly the air inlet section components were not completely disassembled when removed, all the instructions in paragraphs 5-7 through 5-17 will not apply. Therefore, use only the instructions that are necessary as required.

CAUTION

Make sure that all accessories and front frame splines are properly lubricated. Also, be sure all hose connections, fittings, and bolts are properly torqued.

4-94. INLET GUIDE VANE ASSEMBLY.

4-95. INSPECTION.

a. Inspect the inlet guide vane assembly for cracks or pierced holes. Replace inlet guide vane assembly if any such damage is found. Return the damaged assembly to an overhaul activity for repairs.

b. Inspect the inlet guide vanes for nicks. Accept nicks not exceeding 0.020 inch in depth. Replace assembly if nicks exceed this limit. Return the damaged assembly to an overhaul activity for repairs.

c. Inspect the inlet guide vane assembly for dents. Replace the assembly and return it to an overhaul activity if the following limits are exceeded:

(1) Dents in the inner and outer bands may not exceed 5/16 inch in depth.

(2) Dents in the leading edge of the vane may not exceed 3/16 inch in depth and 6 in number.

(3) Dents in the trailing edge of the vane may not exceed 3/16 inch in depth.

(4) Dents in the body of the vane may not exceed 3/16 inch in depth and 6 in number.

d. Replace inlet guide vane assembly if cracks or holes are found; accept nicks, dents, ballooning, and corrosion as satisfactory for continued engine operation.

Note

To insure structural integrity of corroded IGV'S, tap corroded area firmly with the rubber eraser end of a wooden pencil. If the material is broken through or dented during this check, replace the inlet guide vane assembly.

e. Accept ballooning of vanes provided the ballooned section of the vane does not exceed 0.535 inch total thickness. Replace the assembly if this limit is exceeded.

4–96. COMPRESSOR STATOR ASSEMBLY.

4–97. INSPECTION OF COMPRESSOR STATOR ASSEMBLY BEFORE DISASSEMBLY FROM ENGINE. Inspect the compressor stator assembly for blade damage through the engine inlet (refer to paragraph 4–103). If blade damage is detected, remove compressor casing and perform inspection and repair blades (refer to paragraph 4–107).

Note

If blade damage is not detected and stator casings do not require removal, accept a gap of 0.125 inch between the stator blade base and retainer keys at the horizontal split line. If gap exceeds this limit or stator casings require removal, install spacers to bring clearance within limits. (Refer to paragraph 4–100.)

4–98. INSPECTION OF COMPRESSOR STATOR ASSEMBLY AFTER DISASSEMBLY FROM ENGINE. If damage is beyond repairable limits, replace damaged part or entire stator assembly.

Note

When one compressor casing is damaged beyond repair, replace both casings. Compressor casing halves must not be interchanged.

a. Inspect the compressor casing for cracks and breaks. Accept mounting flange bolt hole cracks which extend to the outside edge of the mounting flange, provided that no more than 3 holes on each mounting flange are cracked and that at least 3 unaffected bolt holes remain between cracks. Replace compressor casing if these limits are exceeded, if breaks are present, or if cracks are present in the stator retaining lips.

b. Inspect the compressor casing for scores in the circumferential flanges. Accept scores that do not extend more than 3/4 across the flange width.

c. Inspect the stator ring retaining lips for scores (360°). Repair scoring by blending rough surfaces and edges, provided the following limitations are not exceeded. (See figure 4–25.)

(1) In area "A", repair scores within 9/32 inch of the retaining lip edge, if the scores are not deeper than 0.070 inch.

(2) In area "B", repair scores within 3/16 inch of the retaining lip edge, if scores are not deeper than 0.035 inch.

(3) In area "C", repair scores, if scores are not deeper than 0.020 inch.

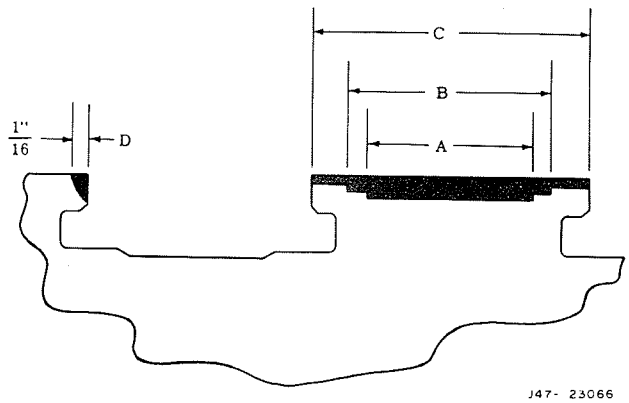


Figure 4–25. Compressor Casing Retaining Lips Repair Area

(4) In area "D", repair scores if scores can be removed by tapering from 1/16 inch to corner of chamfer.

(5) Repair circumferential scoring (360°) in all other areas of the retaining lip section.

d. Inspect the compressor casing for nicks, dents, and similar isolated damage. Repair nicks or dents in areas other than the retaining lip section by removing high metal and blending.

(1) Accept isolated retaining lip gouges larger than those listed in step "c", if there are no broken out areas more than 1/4 inch in length and less than 1-1/2 inch apart.

(2) Repair all other nicks and dents in the retaining lip section.

(3) Accept air extraction pad flange nicks and dents after removal of high metal if the damage does not exceed 1/16 inch in depth and does not extend across the flange more than 3/4 the width.

e. Inspect blade rings for cracks. Replace ring and blade assembly with fabricated stator blades (refer to paragraph 4–106) if damage is found.

f. Inspect blade rings for nicks. Accept nicks less than 1/16 inch diameter between blade slots.

g. Inspect blade ring groove and runner for rough spots and burrs. Remove rough spots and burrs with a fine file and/or polish with emery cloth.

h. Inspect screw bushings (threaded inserts) for looseness and thread damage. Replace, repair, or properly lock all loose or damaged bushings. Replace damaged locking pins with new pins. Repair loose screw bushings that cannot be repaired with new locking pins (refer to paragraph 4–93 "b", steps 1 through 7), making certain to allow a minimum wall thickness of 0.090 inch and to alodine or anodize the repaired area.

i. Repair threaded holes that contain helical inserts within certain limitations. Repair helical inserts that have been damaged (refer to paragraph 4–93 "c", steps

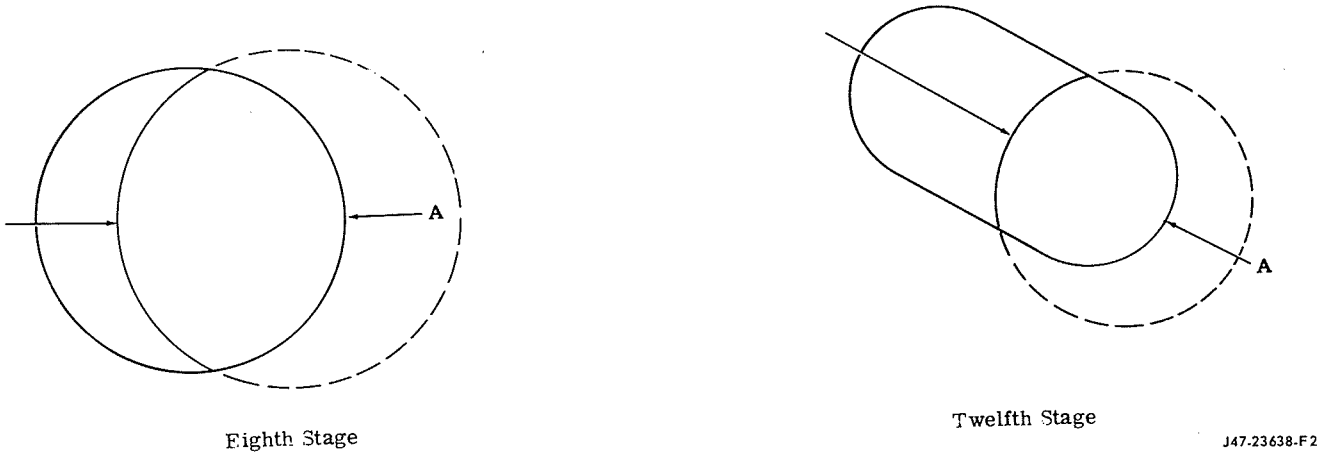


Figure 4–25A. Minimum Clear Hole Diameter

1 through 7), making certain to alodine or anodize the repaired area.

j. Check the minimum clear hole diameter between the eighth- and twelfth-stage ring and blade assemblies, or fabricated blades, and the compressor casing air extraction ports. (See "A", figure 4–25A.) The minimum average clearance should be 0.250 inch. This is an average of all holes in the respective ports. The ring and blade assemblies, or fabricated blades, must be shifted as far as possible in the direction of the engine rotation when the check is made. Replace the ring and blade assembly, or fabricated blades, if this average minimum diameter cannot be maintained or corrected. (Refer to paragraph 4–106 "b".) If the average clearance is less than 0.250 inch on the eighth stage, return the turbine wheel for post emulsification fluorescent-penetrant inspection.

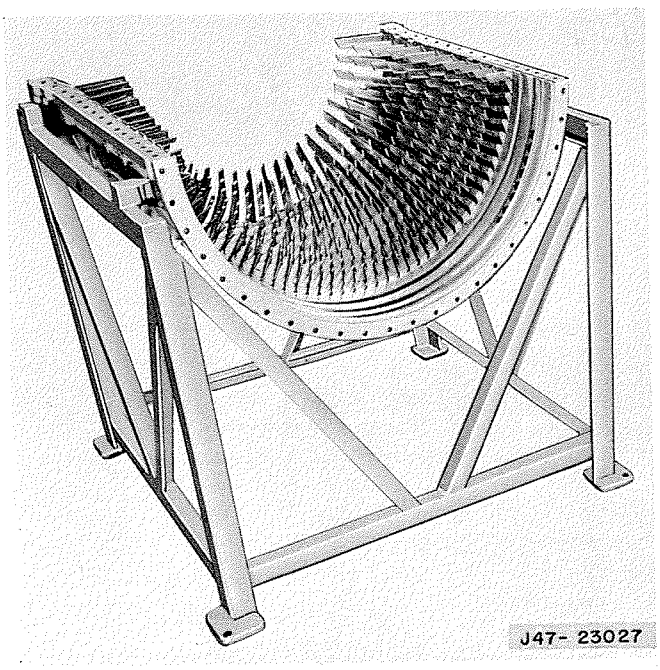


Figure 4–26. Compressor Casing in Stand

4–99. COMPRESSOR STATOR DISASSEMBLY.

a. Place the compressor casing in a suitable stand (figure 4–26) resting on the counterbored side of the horizontal flanges.

b. Remove the keys from the keyway on each flange of the casing with a flat chisel, screwdriver or fingers.

c. Remove necessary blade retaining rings or fabricated blades as follows:

Note

Center all blades in blade ring prior to removal of ring and blade assembly.

(1) Place a dowel of hardwood or textolite against the end of the ring and blade assembly. Tap first one end of the assembly, and then the other end to determine the direction of easiest travel. Drive the assembly in this direction until far end projects about 3 inches.

(2) Remove the burrs or rolled edges from the projecting end with a mill bastard file.

(3) Drive the assembly back into, and completely through, the compressor casing.

(4) Remove fabricated blades from the casing by sliding the blades the easiest way by hand.

Note

Use penetrating oil on the ring assembly or fabricated blade to aid removal.

4–100. COMPRESSOR STATOR REASSEMBLY.

a. Clean the compressor stator casing groove with cleaning solvent, Federal Specification P–S–661b. Remove burrs and rough spots.

b. Apply a paste made of graphite powder, Specification MIL–G–6711, and lubricating oil, Specification

MIL–L–7808, or a mixture of castor oil, Federal Specification JJ–C–86, and penetrating oil, Federal Specification 02–B–3, to the ring groove of the compressor stator casing and fabricated blades.

c. Re-assemble fabricated blades as follows:

(1) Insert the fabricated blades from either end of the casing groove so that the leading edge of the blade airfoil is forward in the casing.

Note

Stage No. 8 of the upper casing half requires 7 fabricated blades with holes in the blade base. Align and match these holes with the 6 air extraction holes in the casing. Stage No. 12 requires 9 fabricated blades for each casing half with holes in the blade base. Align and match these holes with the 8 air extraction holes in the casing. The minimum average clearance between the holes in the blade base and the holes in the air extraction ports should be 0.250 inch. (See A, figure 4–25A.) This is an average of all holes in the respective ports. The blades must be as far as possible in the direction of engine rotation when the check is made. Replace the blades if this average minimum diameter can not be maintained.

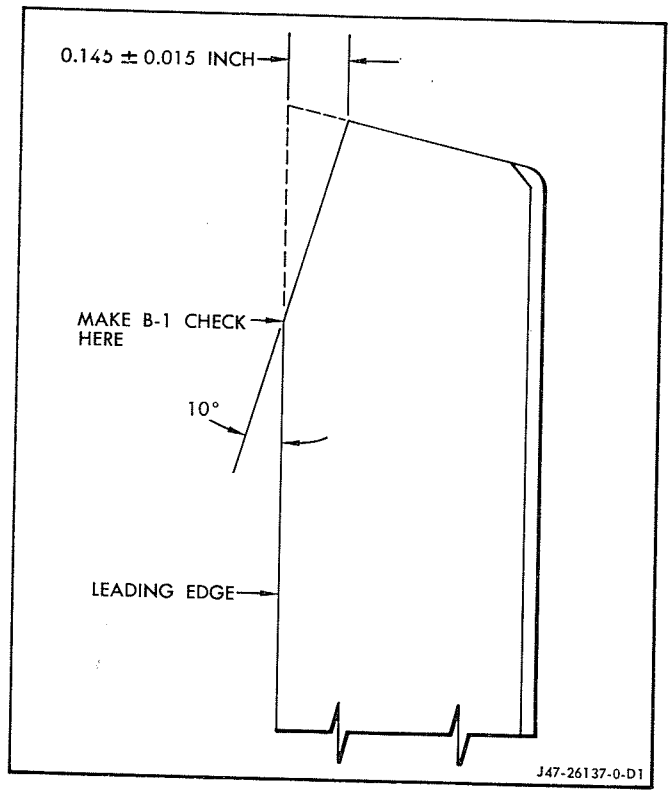


Figure 4–27. Second-Stage Stator Blade Chamfer

(2) Check the clearance at the end of each blade groove between the blade base and retainer keys. If clearance is greater than the thickness of one spacer (0.091 inch nominal) add spacers (a maximum of 3 per stage half) until total clearance is less than the thickness of one spacer.

Note

If one spacer is required per stage half, install it between the first and second blades from either horizontal split line. If 2 spacers are required per stage half, install one between the first and second blades from each horizontal split line. If 3 spacers are required per stage half, install one between the first and second blades from one horizontal line and the other 2 between the first and second, and second and third blades from the other horizontal split line.

(3) Use spacers for fabricated blades. (See figure 4–28.)

d. After all blades have been assembled, place stator casing on surface plate, resting on its aft flange, and make the B–1 check.

e. To make the B–1 check, check individual blades by applying hand pressure to the aft side of the blade and by moving the blade forward as far as possible. While the blade is in this restrained position make a dimensional check (B–1), using a vernier height gage and surface plate, or some equivalent method, at the leading edge tip. (See figure 4–29.)

f. The maximum B–1 dimensions are shown in Table XIV and apply to both forged and fabricated stator blades. Rework any blade that exceeds these dimensions or exhibits interference, as follows:

(1) Second-stage blades—chamfer 0.130 to 0.160 inch at a 10-degree angle from the blade leading edge (figure 4–27). Break or remove all feathered edges after chamfering.

Note

The B–1 dimensions for stages 1, 2, and 3 are less for overhaul than field maintenance. This is to assure further that activities do not receive overhauled engines with blade interference.

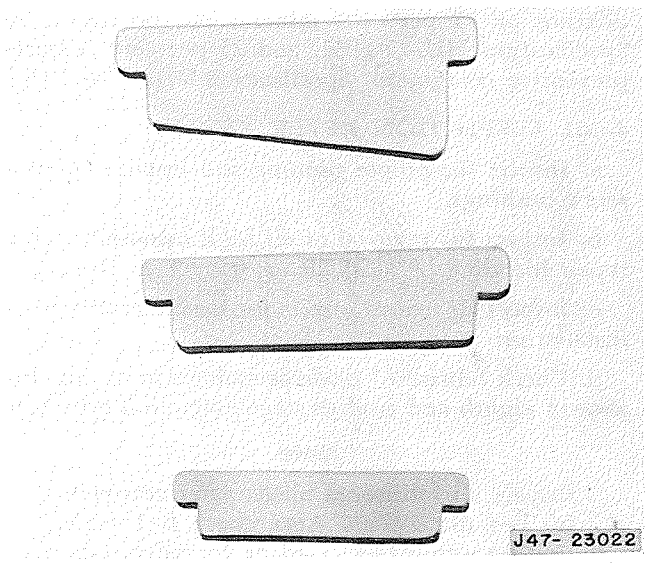


Figure 4–28. Fabricated Blade Spacers

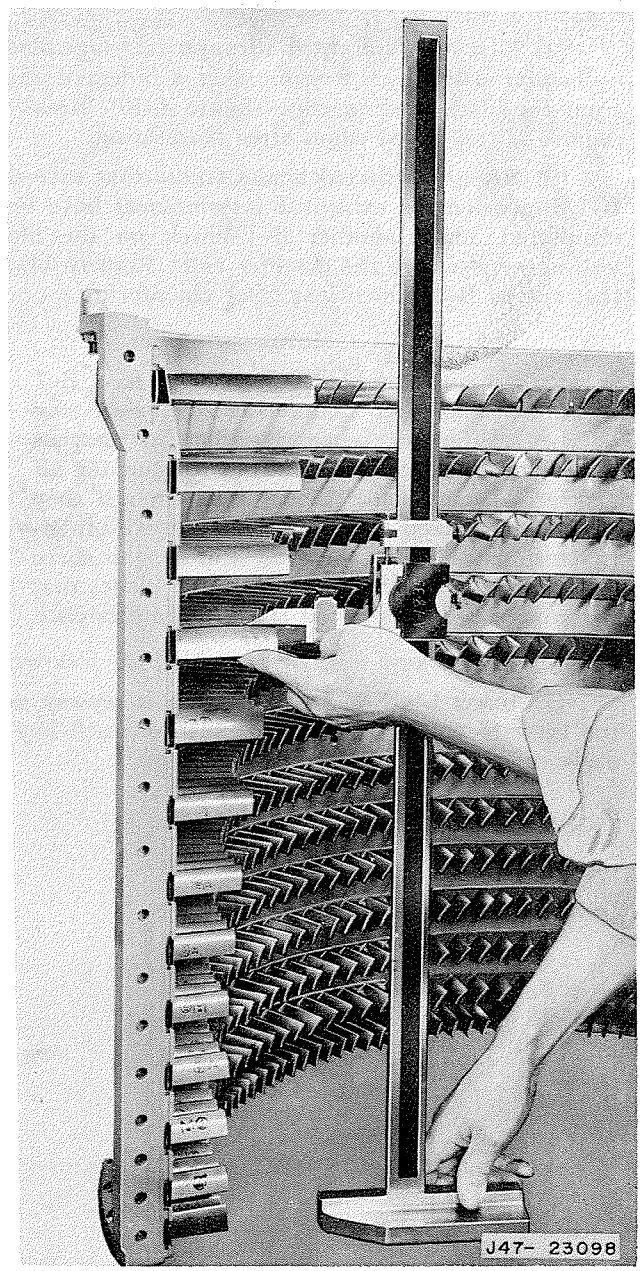


Figure 4–29. Measuring B–1 Dimension

(2) First-stage and third- through exit-stage blades —chamfer 0.040 inch maximum at a 3-degree angle from the blade leading edge (figure 4–30). Break or remove all feathered edges after chamfering.

(3) After all affected blades (those that exceeded B–1 dimensions or exhibited interference) have been chamfered, make another B–1 check on the blade leading edge where the chamfer ends. Replace blades that exceed B–1 dimensions after chamfering.

Note

Do not condemn blades that do not meet B–1 dimensions after chamfering since they may be satisfactory when installed in another stator case. It is permissible to chamfer all second-stage stator blades even though they do not exceed B–1 dimensions or exhibit interference. In stage one and stages three through exit, chamfer only those blades that exceed B–1 dimensions or exhibit interference.

g. Install the keys in each casing half as follows:

(1) Insert key "A" in its respective keyway near the forward end of the casing and peen each key in 4 places, as shown in figure 4–31.

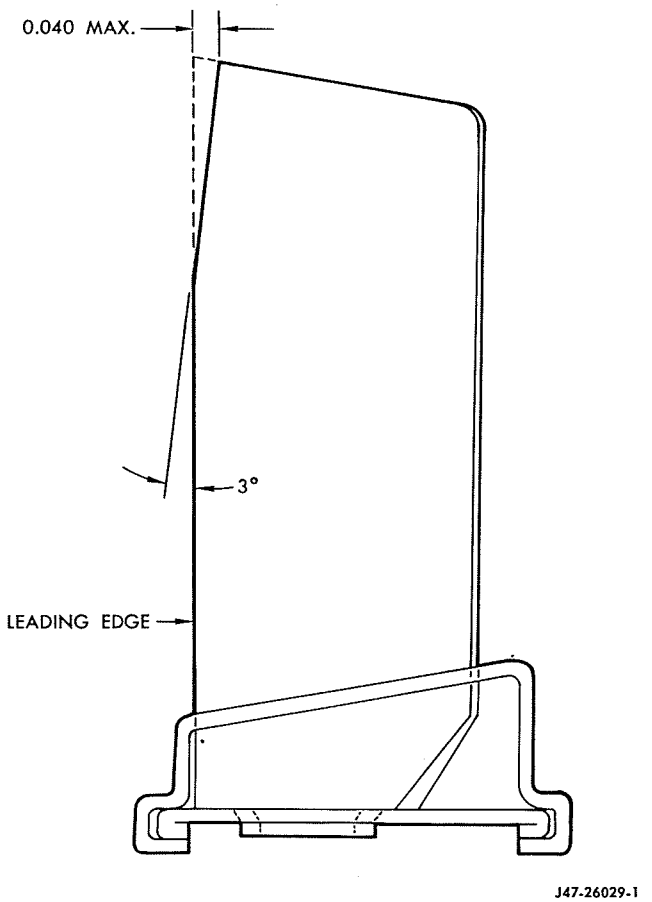


Figure 4–30. First-Stage and Third- Through Exit-Stage Stator Blade Chamfer.

(2) Install keys "B", "C", "D", and "E" in that order in the long keyway. Check for clearance of 0.060 to 0.120 inch between the rabbet on the exit stage end and the end of the key at "E". Peen each key as shown in figure 4–31.

TABLE XIV. MAXIMUM DIMENSIONS (B–1 CHECK)

Stage	Dimension
1	28.325
2	25.419
3	22.765
4	20.128
5	17.497
6	14.863
7	12.443
8	10.401
9	8.376
10	6.382
11	4.436
12	2.607

(3) Repeat procedure on the other flange of the casing half.

CAUTION

Excessive peening can cause serious deformation of the casing. If considerable peening is required, place the key on a steel block and peen until the key is a snug fit in the keyway. Final peening should be done at actual installation.

h. Clean the blades with cleaning solvent, Federal Specification P–S–661B, and spray the blades with a mixture of 75 per cent mineral oil, or engine oil, Specification MIL–O–6031, and 25 per cent corrosion preventive compound, Specification MIL–C–6529A.

4–101. INSPECTION AFTER REPAIR.

a. Inspect for proper pinning and installation of all screw bushings.

b. Inspect for removal of all high metal and proper repair blending of nicks, dents, gouges, or scoring.

c. Inspect all helical inserts for looseness and proper installation.

d. Check fabricated blade assemblies to assure clearance of eighth and twelfth stage extraction port holes.

Note

Inspect all fabricated blades after reassembly for B–1 dimensions. Also, check B–1 dimension on either fabricated or forged blades if there is evidence of blade interference and damage is within allowable rework limits.

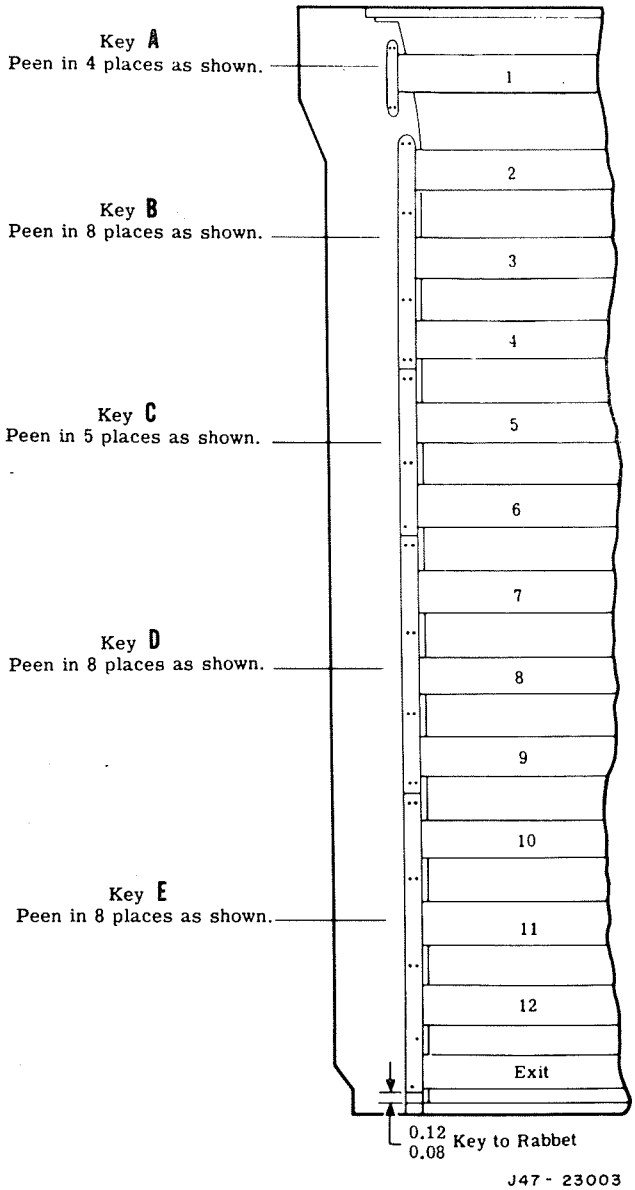


Figure 4-31. Installation and Peening of Keys in Compressor Casing

4-102. COMPRESSOR ROTOR ASSEMBLY.

4-103. INSPECTION THROUGH AIR INLET. Visually inspect the compressor rotor assembly through the engine inlet for damage. If damage is detected, remove compressor casing and perform inspection and repair rotor blades (refer to paragraph 4-107). Inspect the rotor spacer rings and wheel rims (refer to paragraph 4-104).

4-104. INSPECTION AFTER DISASSEMBLY OF COMPRESSOR CASING. If damage is beyond repair, reject the engine.

a. Inspect the spacer rings and wheel rims for cracks. Replace rotor if cracks are found.

b. Inspect the spacer rings and wheel rims for nicks and burrs. Remove any nicks or dents with an Arkansas Stone.

c. Inspect spacer rings for bulges. Accept bulges provided the minimum stator blade to spacer ring clearance (Reference No. 7) is maintained. Replace rotor if clearance is less.

d. Accept circumferential scoring of the rotor wheel spacer rings of stages 1 through 9 up to 0.010 inch in depth. Replace rotor if scoring exceeds this limit. Replace rotor if scoring is found on the tenth and eleventh stage rotor wheel spacer rings.

4-105. COMPRESSOR ROTOR AND STATOR BLADES.

4-106. INSPECTION THROUGH ENGINE INLET. Before disassembly of engine at field maintenance level, visually inspect the compressor blades through the engine inlet. If damage is detected, remove the compressor casing and inspect the blades (refer to paragraph 4-107). Replace compressor blades as follows:

a. Rotor blades: Compressor rotor blades that are damaged beyond repair will be cause for engine rejection to an overhaul facility.

b. Stator blades: Replace compressor stator blades that are damaged beyond repair as follows:

(1) Fabricated blades: Replace fabricated stator blades with other fabricated blades at field maintenance activities.

(2) Forged blades: Replace the ring and blade assembly with fabricated blades in the affected stage and return the ring and blade assembly to overhaul. Replacement of the complete stage, both casing halves, is not necessary.

4-107. INSPECTION AND REPAIR.

a. Inspect rotor and stator blades for damage. Accept no damage without repair unless otherwise stated. Replace stator blades having damage in excess of repairable limits. Reject engine to overhaul if rotor blades have damage exceeding repairable limits. (Refer to paragraph 4-106.)

b. The maximum number of rotor blades to be reworked for leading and trailing edge damage is as follows:

(1) Do not rework more than 5 blades per stage in each 90 degree quadrant of stages 1 through 7.

(2) Do not rework more than 6 blades per stage in each 90 degree quadrant of stages 8 through 12.

(3) Do not rework more than 50 blades in each 90 degree quadrant of the rotor.

Note

Make any number of repairs on the leading and trailing edges of individual blades provided that the material removed does not ex-

ceed the maximum allowable for one edge and the number of blades reworked does not exceed the quantities listed above. Whenever it is necessary to remove the maximum allowable amount of material from one or more rotor blades, subject the engine to a vibration run on a test stand.

c. Rework any number of rotor blades for contour surface damage and/or blade corner damage.

d. Allow any number of stator blades to be reworked.

e. Rework damage in Area B, figure 4–32, such as dents, pits (refer to step "i") mars, or scratches if the damage does not exceed 0.010 inch deep. Blend to a smooth contour.

f. Inspect the rotor and stator blades for damage in the blade contour. Rework any number of damages in Area A, figure 4–32, if the maximum depth of the rework does not exceed 1–32 inch. Repair contour damage as follows:

(1) Repair the contour surfaces with a medium India Stone and finish with emery cloth and/or Ar-

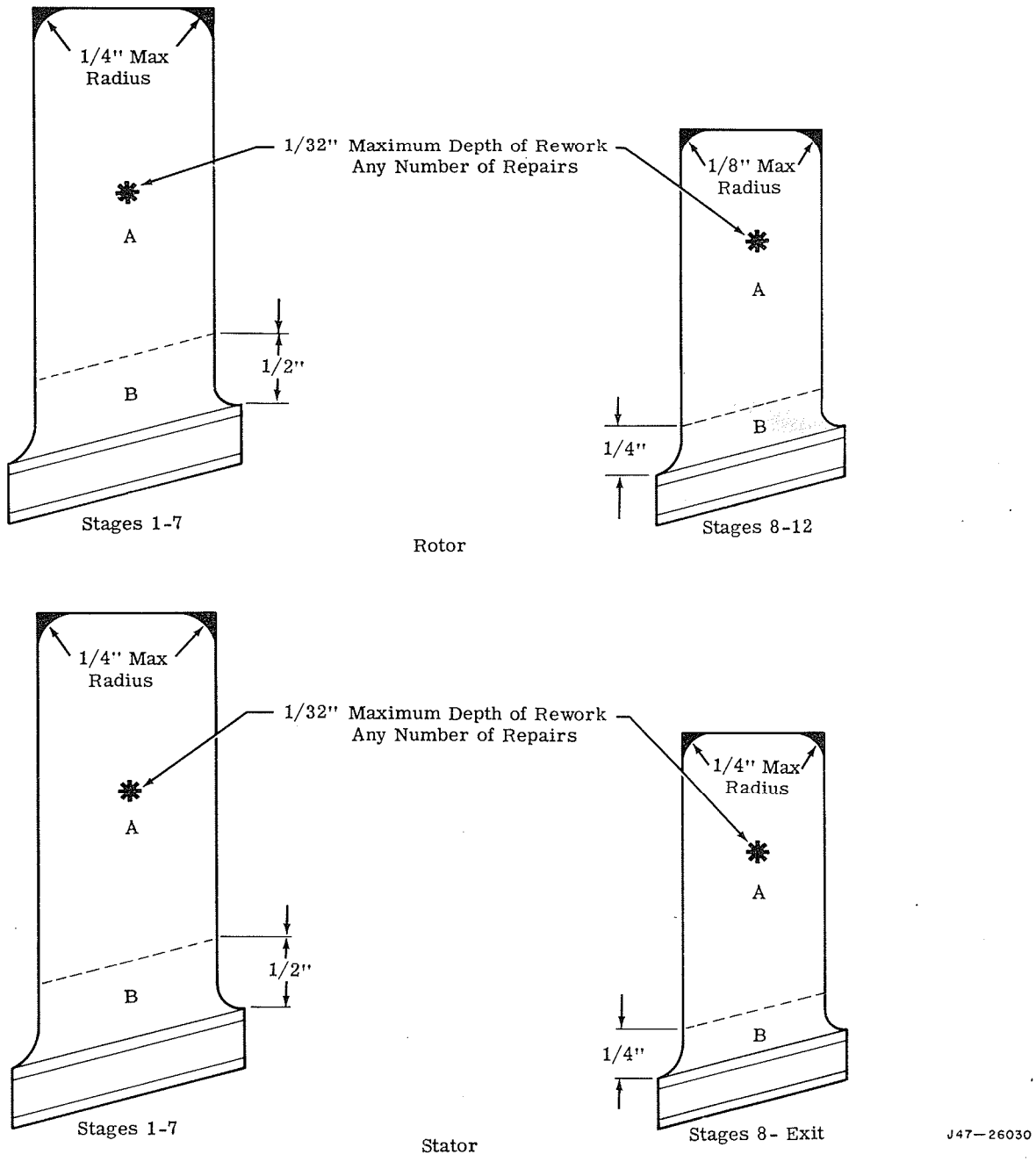


Figure 4–32. Acceptable Blade Tip and Contour Repair

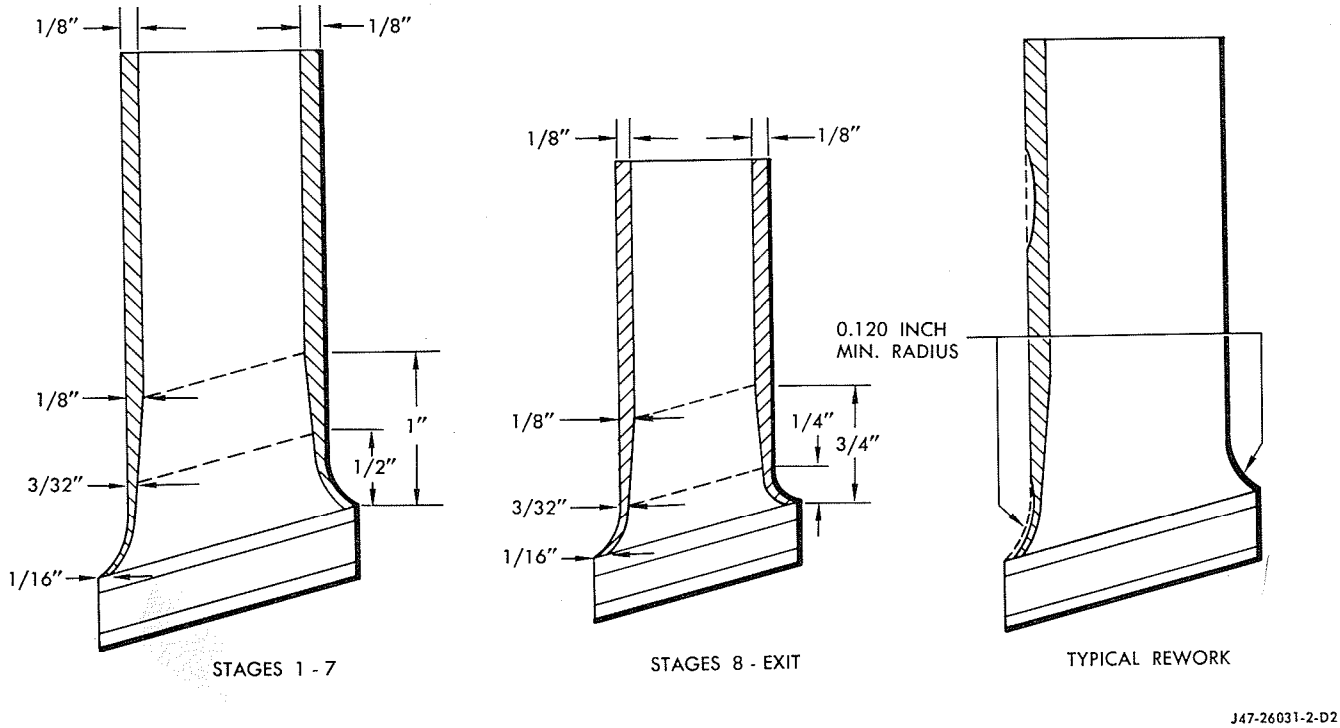


Figure 4–33. Blade Leading and Trailing Edge Rework Limits and Areas (Rotor and Stator)

kansas Stone. The repaired finish should compare as near as possible with the original finish.

(2) Smooth surface roughness resulting from slight operational grit marks by polishing lightly with fine emery cloth.

(3) Blade thickness in any area may not be reduced by more than 1/32 inch; i.e., damage on the blade surface may not be reworked if the damage is opposite reworked damage on the reverse side of blades.

g. Inspect the rotor and stator blades for damage to the blade tip corners. Remove damage by forming a blend radius if the damage can be removed without exceeding the limits stated in figure 4–32.

Note

Corner damage may be repaired on blades that have been reworked to the maximum limits on the leading and/or trailing edges.

Note

All limits specified are in relation to the original blade dimensions and apply to total material removed in accumulated rework. The minimum blade width (chord length) after rework is shown in Table XVII.

h. Repair blade with leading and trailing edge damage, if the damage is within the limits of the repair areas specified in figure 4–33. Accomplish repair as follows:

Figure 4–33A. Deleted

Note

See figures 4–34 (A, B, C) and 4–35 for acceptable airfoil to blade base fillet conditions. These conditions were accepted at overhaul and should be disregarded at field maintenance.

(1) Use a mill smooth file to rework leading and trailing edges which are nicked, dented, or damaged within the repairable limits, if removal of considerable

material is necessary. File at right angles to the chord line (with the blade length).

Note

Use a file only on the leading and trailing edges or for tip corner repair.

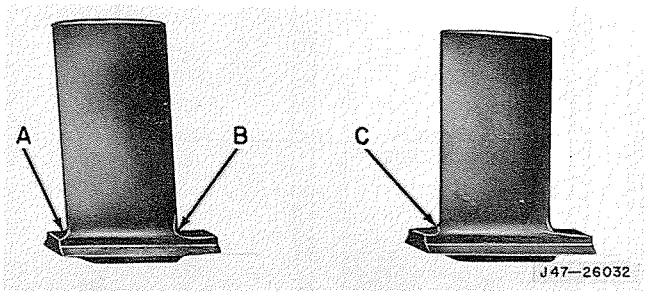


Figure 4–34. Compressor Blade Acceptable Fillet Conditions

(2) Stone areas reworked with a file or areas containing small nicks and dents with a medium India stone.

(3) Polish the reworked area with fine emery cloth and/or an Arkansas stone to compare as near as possible with the original finish. Polish at right angles to the chord line (with the blade length).

(4) Blend leading edges to obtain as near the original configuration as possible. Blend trailing edges sufficiently to remove all sharp edges.

(5) Rework any blade on which the trailing edge cross-section is less than 0.015 inches in thickness (knife edge) to incorporate a radius on the trailing edge that will provide a minimum thickness of 0.015 inch.

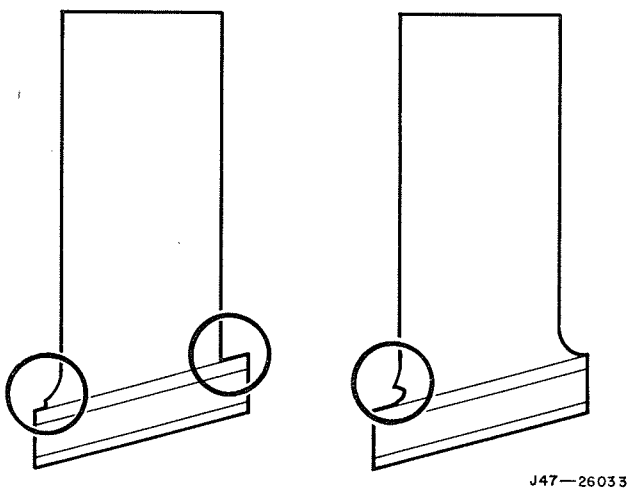


Figure 4–35. Compressor Blade Acceptable Fillet Conditions

(6) Repair any amount of damage (nicks, dents, pitting, etc.) in the leading and trailing edges of the blades, provided the total rework does not exceed the rework allowable for one edge. Repair damage by removing the material in a long blend. Begin at least 1/2 inch below the defect, or in the root area at the blade base, whichever is closer, and continue blend through the damaged metal. Extend the blend beyond the damage point for at least 1/2 inch, or to the blade tip, whichever is closer. (See figure 4–33.)

Note

When reworking damage in the root area, be sure that 0.120-inch minimum radius is maintained. (See "Typical Rework" in figure 4–33.)

i. Inspect for pitting as follows:

(1) Accept pitting on the leading and trailing edges to 1/64-inch diameter. If pitting exceeds these limits, repair as directed in step "h".

(2) Accept pitting on all other surfaces to 1/16-inch diameter and 1/64-inch deep, unless there are concentrated areas of pitting. Pitting is concentrated if the majority of the pits within a 1/2-inch circle have greater than 1/32-inch major surface dimension and are grouped closer than 1/8-inch to each other. If pitting exceeds these limits, repair as directed in steps "e" and "f".

j. Inspect rotor and stator blades for leading and trailing edge warpage.

(1) Repair leading edge warpage if all warpage can be removed within the allowable leading edge rework limits. (See figure 4–33.)

(2) Accept trailing edge warpage provided limits in Table XV are not exceeded. (See figure 4–36.) Use a straight edge and thickness gage, or other equivalent method, to perform the inspection.

(3) If limits are exceeded for stator blades, replace blades. If limits are exceeded for rotor blades, refer to paragraph 4–106, step "a".

k. Inspect rotor and stator blades for corrosion.

(1) Remove corrosion which has resulted in surface build-up that can be detected by touch from the compressor blades with a 320 grit emery cloth attached to a high speed spindle or with a rag buffing wheel and rough compound. Repair at right angles to the chord line (with the blade length).

TABLE XV. BLADE TRAILING EDGE WARPAGE LIMITS

Stages	Area A	Area B	Area C
1 and 2	9/64 in.	5/64 in.	5/64 in.
3 through 5	7/64 in.	1/16 in.	1/16 in.
6 through 9	5/64 in.	3/64 in.	3/64 in.
10 through Exit	3/64 in.	1/32 in.	1/32 in.

Note

When using the high speed spindle or rag buffing wheel, do not overheat the blades.

(2) If rag buffers and high speed spindles are not available, hand-polish the corrosion with 600 grit emery cloth, parallel to the blade length.

Note

Accept discoloration on compressor blades which does not reflect the characteristic red-dish-brown of iron oxide if it is not rough to touch. Remove rough discoloration by polishing.

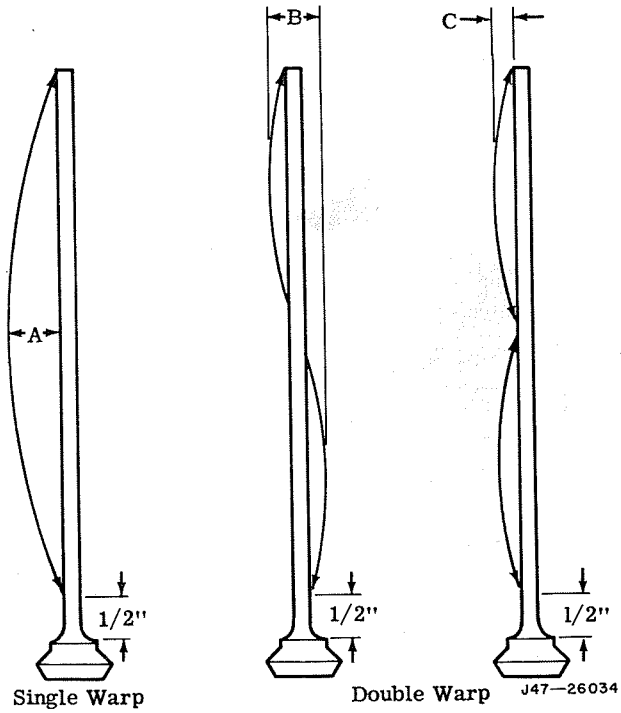


Figure 4–36. Blade Warpage Areas

l. Inspect rotor and stator forged blades for circumferential looseness.

(1) Circumferential looseness (tip shake) is the looseness between the blade and wheel or blade and ring. This motion is to be obtained without stressing the blade, wheel or ring.

(2) Grasp the blade at the root with the thumb and fore-finger and try to move it. If it moves, measure with a dial indicator attached to an adjacent blade.

(3) Accept forged stator blades with circumferential looseness not exceeding the acceptable limits in Table XVI. If looseness exceeds the acceptable limit but is less than the replacement limit, peen the blades. If less than 50 percent of the stator blades per stage in a stator half exceed the replacement limit, replace the affected blades. If more than 50 percent of the blades per stage in a stator half exceed the replacement limit, replace all blades in that stage of the stator half.

Note

Circumferential looseness (tip shake) does not apply to fabricated stator blades. Looseness of fabricated blades is acceptable so long as they meet B–1 dimensions.

(4) Accept rotor blades with circumferential looseness not exceeding the acceptable limits in Table XVI. If looseness exceeds the acceptable limit, but is less than the replacement limit, peen the blade. If any rotor blade exceeds the replacement limit, reject the engine to an overhaul facility.

TABLE XVI. TIP SHAKE LIMITS FOR FORGED BLADES

COMPRESSOR ROTOR BLADES			COMPRESSOR STATOR BLADES		
Stage	Acceptable Limit	Replacement Limit	Stage	Acceptable Limit	Replacement Limit
1	0.029	0.087	1	0.026	0.078
2	0.024	0.072	2	0.022	0.066
3	0.021	0.063	3	0.020	0.060
4	0.020	0.060	4	0.018	0.054
5	0.018	0.054	5	0.016	0.048
6	0.016	0.048	6	0.014	0.042
7	0.015	0.045	7	0.012	0.036
8	0.013	0.039	8	0.011	0.033
9	0.012	0.036	9	0.010	0.030
10	0.011	0.033	10	0.010	0.030
11	0.011	0.033	11	0.010	0.030
12	0.011	0.033	12	0.010	0.030
			(Exit) 13	0.010	0.030

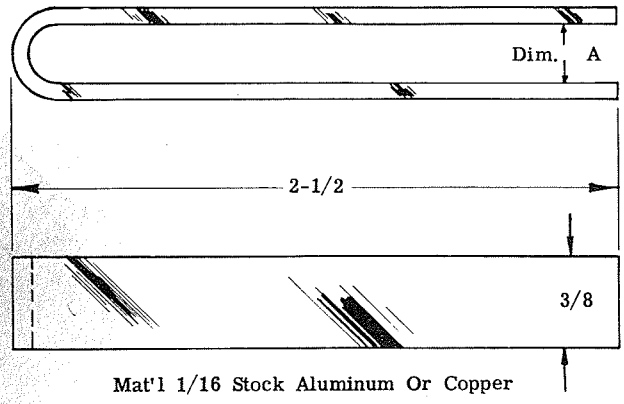
TABLE XVII. ROTOR AND STATOR BLADE MINIMUM CHORD LENGTH (BLADE WIDTH) AFTER REPAIR

STAGE	ROTOR	STATOR
1	1.123(Tip) 1.282(Root)	1.025
2	1.155	0.960
3	1.155	0.960
4	1.155	0.960
5	1.155	0.960
6	1.155	0.705
7	1.155	0.705
8	0.855	0.705
9	0.855	0.705
10	0.855	0.705
11	0.855	0.705
12	0.855	0.705
Exit		

*The first-stage rotor blades are tapered; therefore, the blade chord length is given for both the tip and root area.

(5) If circumferential looseness (tip shake) is beyond the acceptable limits and not in excess of the replacement limit, peen as follows:

(a) Rotor Blades: Place shim stock at base of blade flat on wheel, covering the old punch marks. Position brass or aluminum spacer (figure 4–37). Punch twice on each side of the blade slot as in figure 4–38. Use a punch (figure 4–39). The blade should be tightened to within the acceptable limits in table XVI.



PT	DIM. A	STAGES ROTOR
2	3/16 ± 1/64	2-12
3	1/4 ± 1/64	1

J47-23323

Figure 4–37. Compressor Blade Spacer Tool

Note

The purpose of peening is not to remove all looseness, but to control looseness.

(b) Stator Blades: Place spacer in position. (See figure 4–37.) Punch on each side of the blade (figure 4–38) with sufficient force to tighten the blade to within limits in table XVI. Use a punch (figure 4–39).

CAUTION

Be careful when placing the punch on the surface of shim stock on the rotors, and when punching the old punching marks on stator rings.

m. Inspect the fabricated stator blades for damage as follows:

(1) Inspect the fabricated stator blade airfoil section for damage as outlined for forged blades.

Note

Fabricated stator blades consist of a forged air foil surface brazed to a fabricated base. (See figure 4–40.) Fabricated stator blades are interchangeable with ring and blade assemblies in any stage of a compressor casing.

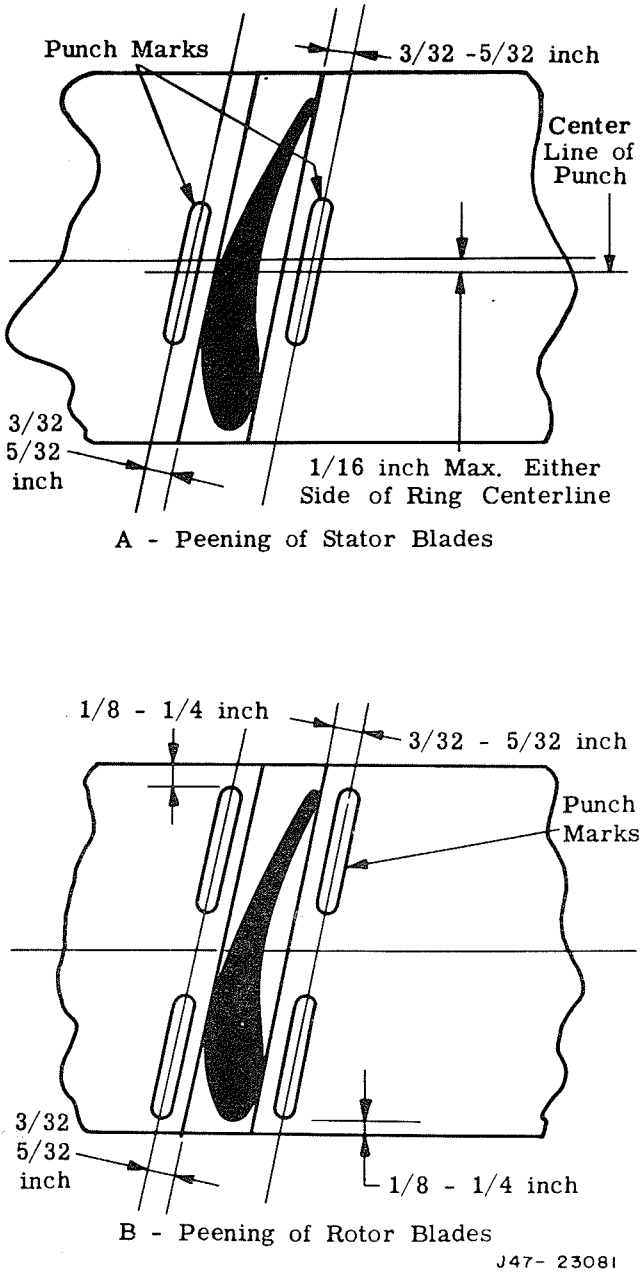


Figure 4–38. Location of Punch Marks for Peening

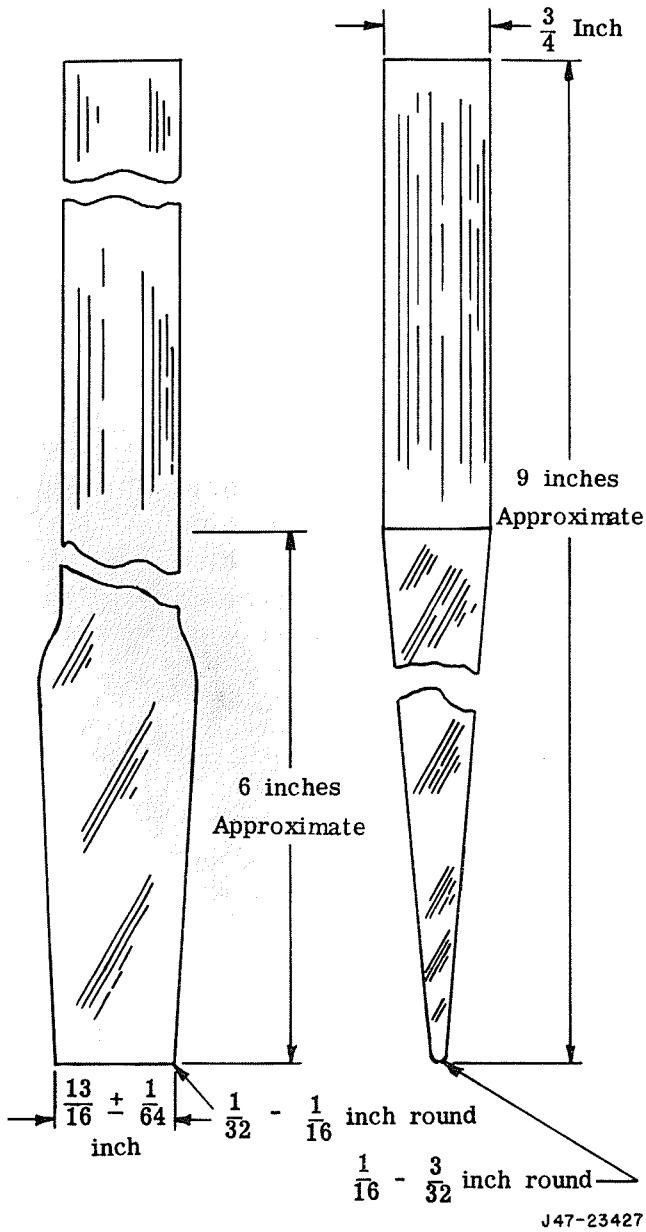


Figure 4–39. Compressor Rotor Blade Peening Tool

(2) Inspect the fabricated stator blade base brazing limits as follows:

(a) Accept skips or braze inclusions provided no one skip or inclusion is greater than 1/16 inch in length and the cumulative length of all skips and inclusions is no greater than 1/8 inch.

(b) Accept braze fillet provided the fillet is no greater than 1/8 inch radius.

(c) Accept minor braze spatter on blade airfoil.

(d) Replace blade (refer to paragraph 4–106) if cracks are found between blade airfoil section and blade base. (See figure 4–41.)

n. Inspect sintered compressor stator blades for damage.

Note

Sintered compressor blades are similar to those of forged design but are made from different material. These blades can usually be identified by the chrome plated finish and may be found in all stages of compressor stator casing assemblies, P/N 7025R46 (J47–25 and –27 engines), and stages 6 through exit of assemblies, P/N 7026R65 (J47–25 engine).

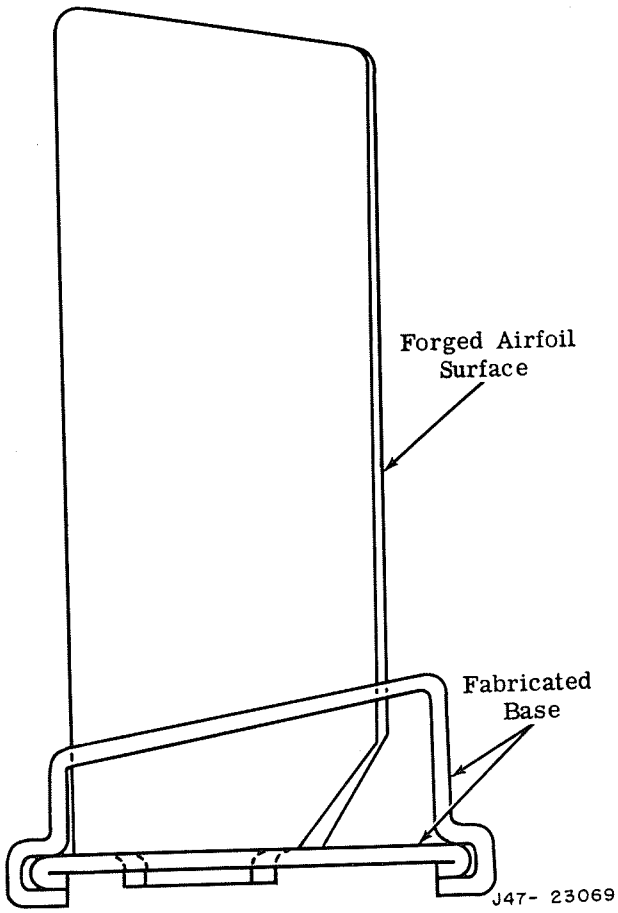


Figure 4-40. Fabricated Compressor Blades

(1) Do not repair sintered stator blades.

(2) Replace sintered stator blades that show corrosion, chipping, or flaking of the chrome plating.

(3) If sintered stator blades are loose use limits set up in table XVI, and peen (refer to paragraph 4-107.)

4-108. COMPRESSOR REAR FRAME.

4-109. INSPECTION AND REPAIR.

a. Inspect the compressor rear frame for cracks. Accept mounting flange bolt hole cracks extending to the outside edge of the flange provided that not more than 3 holes are cracked and that at least 3 unaffected bolt holes remain between cracks. If these limits are exceeded, or if cracks are found in any location other than the firewall or in the cabin take-off ports, reject the engine.

b. Inspect the compressor rear frame firewall for cracks or breaks. Accept cracks or breaks totaling 3 inches in length in the firewall flange lip, after grinding out and blending to a smooth contour. (See figure 4-42.) Accept cracks emanating from hose, tube or cable holes and extending through the firewall flange, or cracks emanating from bolt holes and extending into the hose, tube or

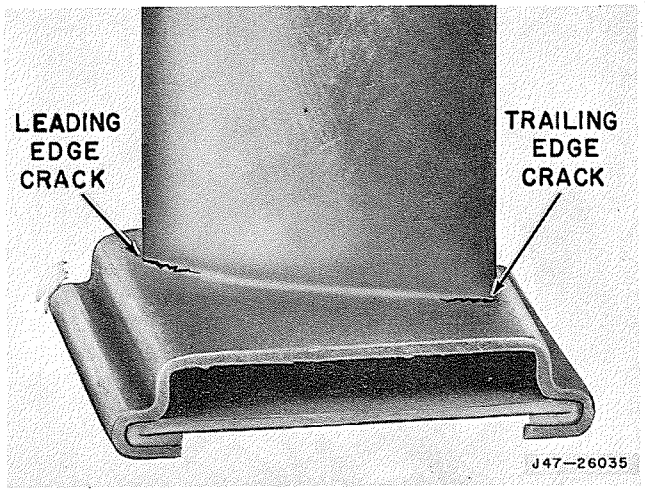


Figure 4-41. Fabricated Stator Blade Airfoil to Base Crack

cable holes, provided the cracks will not cause pieces of flange to break away. (See figure 4-43.)

c. Inspect the cabin take-off ports in the compressor rear frame for cracks. Rework by grinding out cracks with a portable grinder, provided the following limits are not exceeded. (See figure 4-44.)

WARNING

Block off area X on every port to prevent metal filings from entering 12th stage air seal area. Thoroughly clean all areas inside the rear frame before and after removal of blocking material.

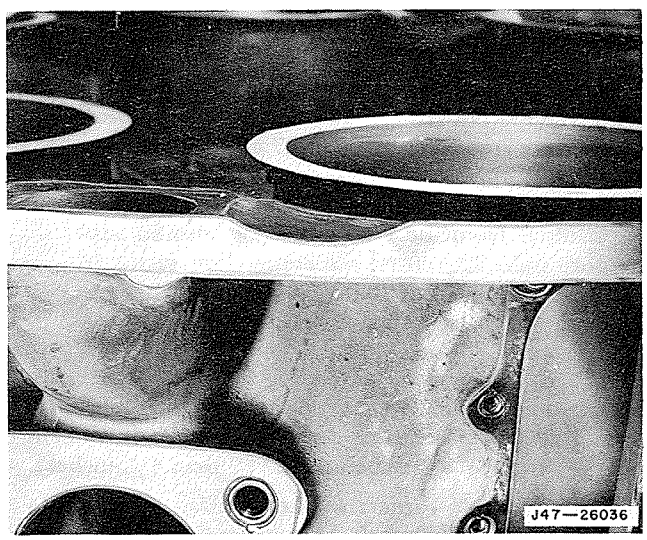


Figure 4-42. Compressor Rear Frame Flange Lip After Blending

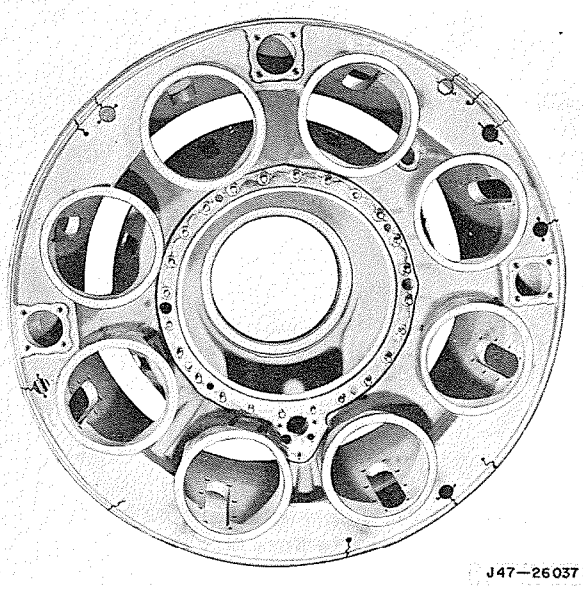


Figure 4-43. Compressor Rear Frame Flange Holes, Acceptable Cracks

WARNING

Take precautions, such as wearing goggles, to avoid injury from the metal filings.

(1) Rework cracks extending forward from the cabin take-off ports that do not extend farther than 9½ inches from the combustion chamber rear flange (that is, dimensions "Z," figure 4-44, must not be longer than 9½ inches, or alternate dimensions "X" must not be less than 2¾ inches).

Note

The "Z" and "X" dimensions of 9½ and 2¾ inches are not critical. There are some compressor rear frames on which "Z" and "X" dimensions of 10¾ and 2 inches, respectively, can be held and rework will not result in removal of material from the No. 2 bearing housing support web. Therefore, the controlling factor in repair of cracks is that grinding must not extend into the support web (G).

(2) Rework cracks extending aft from the cabin take-off ports that do not approach the combustion chamber flange closer than 4½ inches (that is, dimension "Y", figure 4-44, must not be less than 4½ inches).

(3) Grind all corners of the repaired section to a minimum radius of ⅝ inch. Do not let the grinding extend beyond the width of the port more than ⅜ inch on either side (figure 4-44). Figure 4-45 shows port holes after rework.

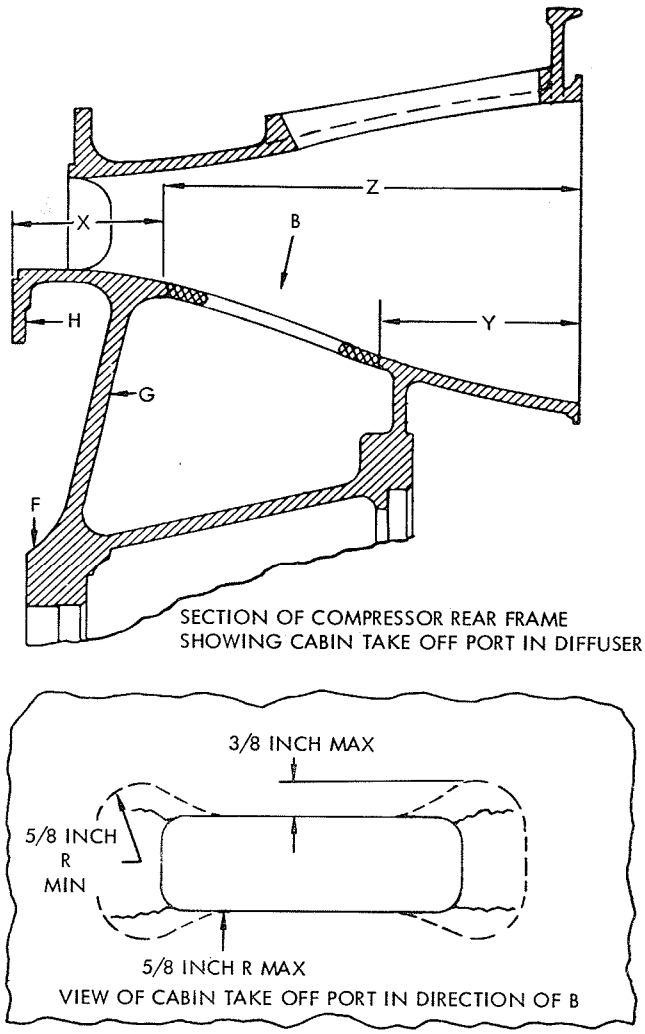


Figure 4-44. Compressor Rear Frame Cabin Take-off Port Repair Limits

(4) Rework all 8 cabin take-off ports to the above limits even though no cracks are evident.

CAUTION

Remove all burrs and round all sharp or machined edges to a 3/32 inch minimum radius; otherwise cracks will develop from the sharp edges and the rework accomplished will be of no benefit.

(5) Rear frames having any number of cracks beyond port crack preventive rework limits may be continued in service provided not more than one crack per port or a total of three per rear frame enter the thin portion of the web "G" and none extend more than one-half the distance to the No. 2 bearing housing bore "F". One or

more of these three allowable cracks may extend forward through flange "H".

d. Inspect the mounting flanges for nicks and burrs. Remove any nicks and burrs with an Arkansas stone.

e. Inspect tapped holes for damaged threads or helical insert damage. Replace, repair, or properly lock screw bushings (threaded inserts) that are loose or have damaged threads. Remove and replace damaged locking pins with new pins. Repair loose screw bushings that cannot be repaired with new locking pins as follows:

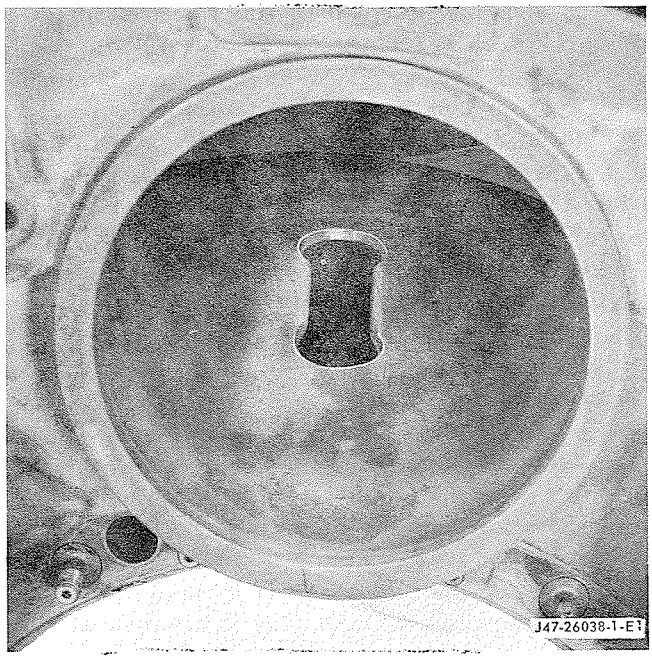


Figure 4-45. Compressor Rear Frame Cabin Take-off Port After Rework

(1) Drill out the old locking pin and remove the bushing.

(2) Inspect the hole and threads, then determine the size (OD) of the replacement bushing. Use the next size, if necessary, but care should be taken to maintain a minimum wall thickness of 0.060 inch and an interference fit of 0.001 to 0.003 inch.

NOTE

For the assembly of screw bushings (threaded inserts) refer to paragraph 8-28. To determine the proper insert, refer to Table XLVII.

(3) Redrill and tap to specified size.

(4) Alodine or anodize the repaired area if facilities are available.

(5) Insert the selected bushing with its external threads coated with zinc chromate primer to 0.005 to 0.030 inch below the surface.

(6) Drill the lockpin hole and pin the bushing in place. Pins 1/8 inch diameter may be used in trunnion pad screw bushings.

(7) Clean and inspect.

f. Inspect the compressor rear frame for nicks, scratches, burrs or gouges.

(1) Accept diffuser flange face nicks or scratches after removal of high metal if they are less than 1/6 inch in depth and do not extend across the flange more than 3/4 of its width.

(2) Accept isolated nicks, burrs, or gouges not deeper than 3/32 inch and not exceeding 1/4 inch in diameter after removal of high metal.

(3) Remove high metal with an Arkansas stone, emery cloth, or fine file.

g. Inspect studs for looseness and proper installation. The top of the stud shoulder shall be flush with or below the surface of the flange. Loose or damaged studs may be replaced if a torque of 420-480 pound-inches can be attained and the stud shoulder is flush with or below the surface of the flange. Re-pin the stud, using an oversize pin if necessary. Peen metal lightly over pin.

NOTE

Use zinc chromate primer on stud threads before installing into the rear frame.

h. Deleted.

i. Alodine or anodize all repair areas if facilities are available.

4-110. INSPECTION AND REPAIR OF COMBUSTION SECTION.

4-111. CROSS-IGNITION TUBE ASSEMBLY (ELLIPTICAL TYPE).

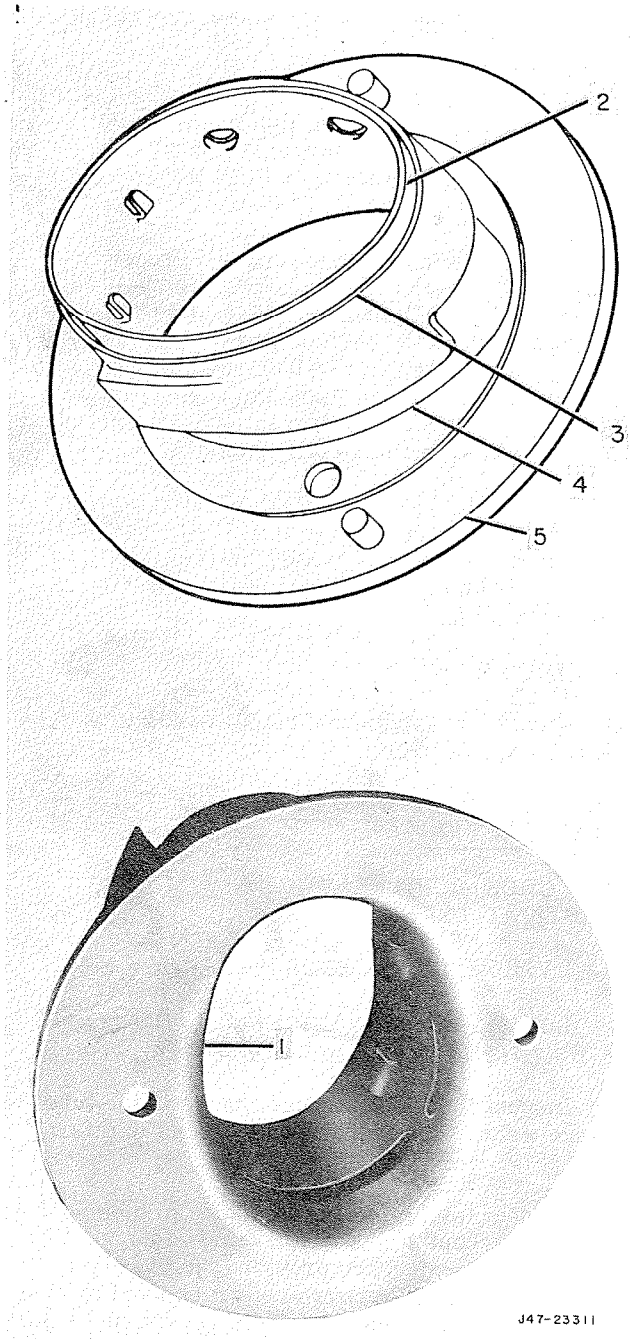
4-112. VISUAL INSPECTION. (See figure 4-46.)

a. Inspect for cracks in the tube to flange weld (1). Weld repair cracks in this area.

b. Inspect for multiple heat checks in the tube to flange weld. Weld repair heat checks in this area.

c. Inspect for cracks on the scoop to tube spot welds (4). Accept 2 spot welds cracked completely around the circumference provided spot welds at each end of the scoop are free of cracks and broken spot welds are not adjacent. Weld repair spot welds cracked beyond this limit.

d. Inspect for cracks in the parent metal of the tube (2).



1. Tube Assembly Weld Flange
2. Tube Body
3. Scoop
4. Spot Weld Area
5. Flange

Figure 4-46. Cross-Ignition Tube Assembly (Elliptical Type)

(1) Accept one 1/8 inch long axial cracks.

(2) Weld repair any number of cracks not exceeding 1/8 inch in length.

(3) Weld repair a maximum of 3 cracks 1/8 inch to 3/8 inch in length, provided cracks are spaced a minimum of 1/2 inch apart.

(4) Replace tube assembly if cracks in tube are beyond repairable limits.

e. Inspect for multiple heat check around the inside of the tube (figure 4-47). Replace tube assemblies with multiple heat checks in this area.

f. Inspect for cracks in the flange (5) and scoop (3). Replace the tube assembly if the flange or scoop is cracked.

g. Inspect for nicks, dents, and bends in the scoop (3) as follows:

(1) Accept the tube assembly if the distance between the scoop and the tube body is not less than 0.0625 inch.

(2) Repair the tube assembly if the distance between the scoop and the tube body is less than 0.0625 inch.

(3) Accept nicks not exceeding one-half the metal thickness. Replace the cross ignition tube if nicks exceed this limit.

h. Inspect flange mating surfaces (5) for flatness within 0.005 inch by using a surface plate and feeler gage. Accept flange mating surfaces flat within 0.005 inch. Repair flanges if flatness exceeds 0.005 inch.

i. Inspect for mutilated or broken pins. Replace mutilated or broken pins if spare pins are available. Replace the tube assembly if spare pins are not available.

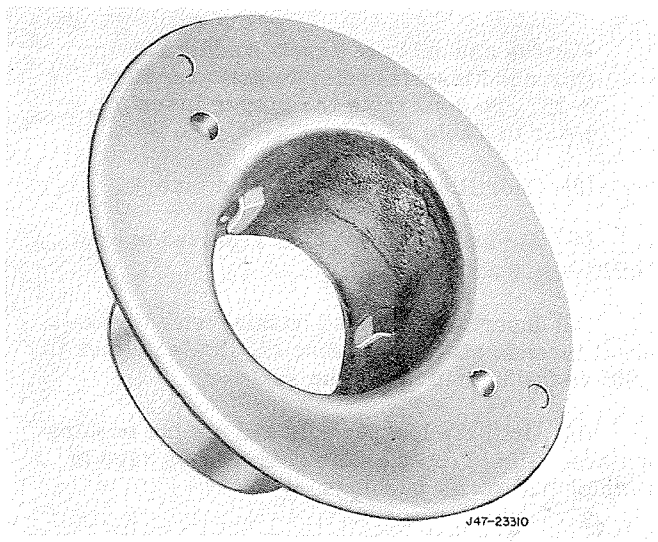


Figure 4-47. Heat Checking on Inside Surface of Tube Assembly (Elliptical Type)

–113. REPAIR.

a. Weld repair the elliptical tube assembly using nconel rod, Specification MIL–R–5031, Class 8A. Hold /eld bead height to a minimum to avoid unnecessary rinding.

b. V-groove all repairable cracks in tube and tube to lange weld to receive full weld penetration.

Note

When performing tube welding, the area should be backed up with a piece of 1/16 inch copper shim to prevent excessive penetration.

c. Repair weld cracks in spot welds using the inert irc process and grind weld height to within 0.020 inch)f the surrounding material.

d. Straighten bent scoops and remove dents, using in applicable tool, to bring the distance between the ube body and the scoop to a minimum of 0.0625 inch.

e. Remove high metal from all acceptable nicks and scratches by any suitable method.

f. Straighten, as much as possible, flange mating surfaces distorted more than 0.005 inch, using a fixture similar to figure 4–48. Resurface flange face after straightening, if necessary. Resurface by removing the minimum amount of material (minimum allowable flange thickness is 0.110 inch) necessary to obtain the required flatness in an area at least 3/8 inch wide when measured at the narrow section of the flange, and 9/16 inch wide when measured at the wide section.

CAUTION

Do not use steel hammers to straighten tube flanges.

g. Repair tubes having mutilated or broken pins as follows:

(1) Drill old pin from flange.

(2) Obtain a serviceable pin for replacement or make a new pin from inconel rod, as indicated in figure 4–48A.

(3) Insert pin in position and weld.

(4) Pin must protrude 0.180 to 0.200 inch from surface of flange. (See figure 4–48A.)

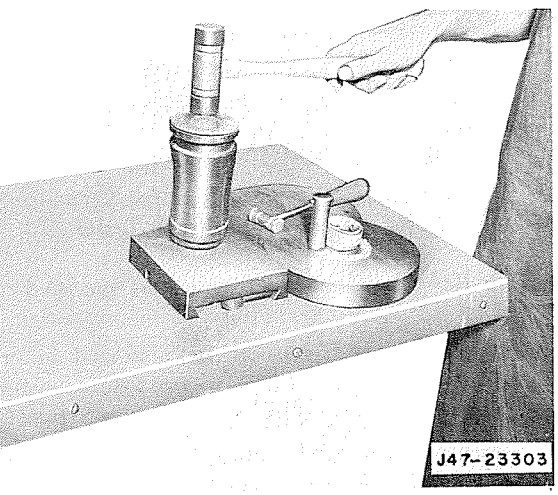


Figure 4–48. Fixture for Straightening Tube Assembly Flange

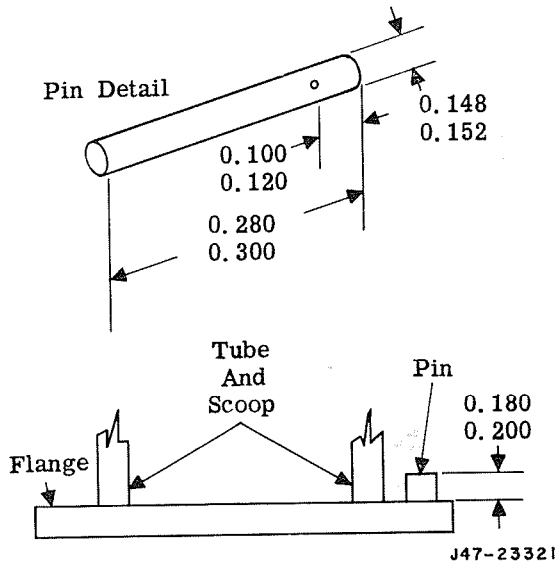


Figure 4–48A. Tube Assembly Alignment Pin Dimensions and Installation Instructions

h. Visually inspect tube assemblies subjected to repair welding to determine the possibility of cracks.

4–114. CROSS IGNITION TUBE ASSEMBLY (BELLOWS TYPE).

4–115. VISUAL INSPECTION.

a. Inspect the tube assembly for cracks in the bellows area. Replace tube assemblies having cracks in this area (1, figure 4–49).

b. Inspect the inner tube for cracks. Replace inner tubes having cracks (1, figure 4–50).

c. Inspect for cracks in the weld between the mating flange and the bellows tube. Weld repair cracks in this area (4, figure 4–50).

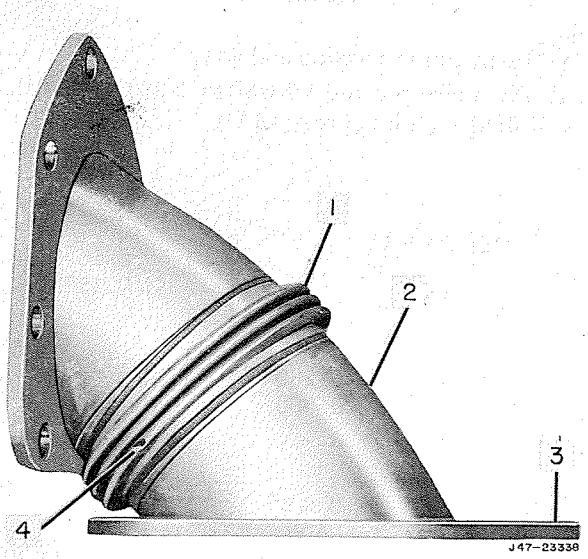
d. Inspect the 4 tack welds for cracks at the inner tube guide. Weld repair cracked tack welds (2, figure 4–50).

e. Inspect the outer tube and bellows area for burned spots. Replace the tube assembly if this condition is present.

f. Inspect the inner tube for distortion and burns. Replace distorted or burned inner tubes if spare tubes are available.

g. Inspect the tube assembly bellows area for nicks and dents. Accept minor nicks and dents that show no signs of leakage. Replace the cross ignition tube if leakage is apparent or if the damage is considered to be serious.

h. Inspect for nicks, dents, and scratches in the outer tube surface (2, figure 4–49). Dents are acceptable, provided there is not less than 1/32 inch clear-



1. Bellows Area
2. Outer Tube Surface
3. Outer Tube Flange Weld
4. Bellows Area Damage

Figure 4–49. Inspection Locations for Outer Tube

ance between the inner and outer tubes. Accept nicks and scratches not exceeding 1/64 inch in depth. Replace the cross ignition tube if these limits are exceeded.

i. Inspect flange mating surfaces for distortion, using a surface plate and feeler gage. Resurface the flange mating surface if distortion exceeds a maximum of 0.010 inch. Maintain a minimum flange thickness of 0.170 inch (3, figure 4–50).

j. Inspect the inner tube guide for wear. Replace inner tube guides worn less than 0.025 inch metal thickness, if spare guides are available. Replace the tube assembly if spare guides are not available.

4–116. REPAIR.

a. Accomplish all repair welding to the bellows type tube assembly with the inert arc process, using inconel filler rod, Specification MIL-R-5031, Class 8A. Hold weld bead height to a minimum to avoid unnecessary grinding.

b. Replace inner tube guide as follows:

(1) Grind through the tack welds holding the guide.

(2) Remove the inner tube guide.

(3) Place a new or serviceable guide in position and tack weld.

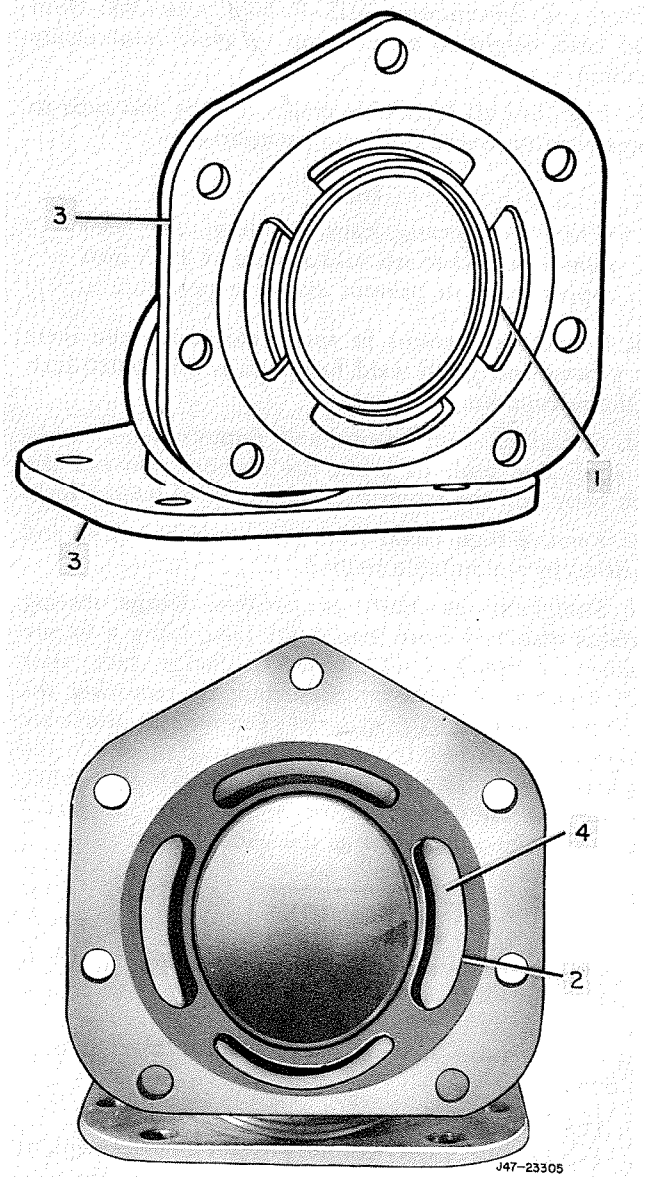
(4) Grind protruding tack welds flush with mating surface.

c. Repair cracks in weld between outer tube and flange as follows:

(1) Remove inner tube guide as specified in step "b".

(2) Perform necessary repair welding.

(3) Remove high metal from welds.



1. Inner Tube
2. Inner Tube Guide
3. Flange Mating Surfaces
4. Weld between Mating Flanges and Bellows Tube

Figure 4–50. Inspection Locations for Cross-Ignition, Tube Assembly (Bellows Type)

(4) Re-install inner tube guide as specified in step "b".

d. Replace cracked, burned, or distorted inner tube with a serviceable part. Refer to procedure outlined in step "b" for removing and replacing inner tube guide.

e. Straighten distorted mating flange seating surfaces using a steel block and brass hammer, or equivalent. Resurface after straightening, if necessary. Do not reduce flange thickness to less than 0.140 inch.

Note

Do not use steel hammers to straighten flanges.

f. Repair cracks in inner tube guide tack welds by grinding to base of crack, filling with weld, and grinding protruding welds flush with flange surface.

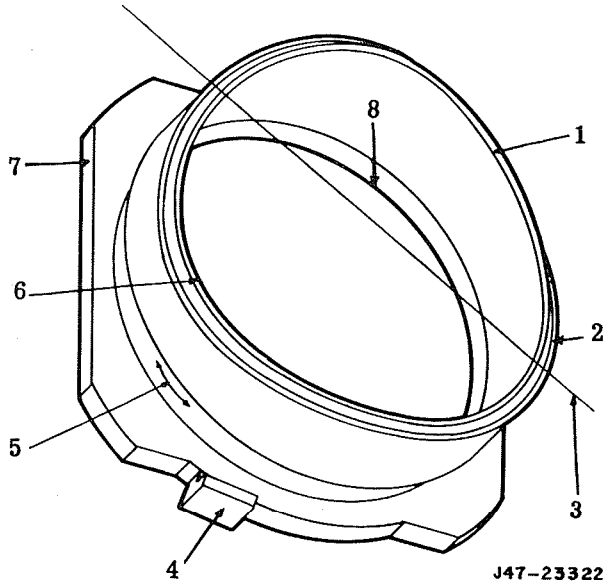
g. Remove high metal from nicks and scratches on outside surfaces of outer tube using a fine file, Arkansas stone, or other suitable method.

h. Visually re-inspect tube assemblies subjected to repair welding.

4–117. CROSS-IGNITION INNER CONNECTOR (BELLOWS TYPE).

4–118. VISUAL INSPECTION. (See figure 4–51).

a. Inspect for cracked spot welds (5). Accept 2 spot welds cracked completely around the circumference provided spot welds at each end of the scoop are free of cracks, and broken spot welds are not adjacent. Weld repair spot welds cracked beyond this limit.



1. Aft End of Tube
2. Scoop Surface
3. 180 Degree Quadrant
4. Tabs
5. Spot Welds
6. Tube Surface
7. Flange Mating Surface
8. Flange Weld

Figure 4–51. Inspection Locations for Cross-Ignition Inner Connector (Bellows Type)

b. Inspect for cracks in the flange to tube weld. Repair cracks in this area.

c. Inspect for cracks in the tube (6) as follows:

(1) Repair any number of cracks 1/8 inch or less in length.

(2) Repair a maximum of 3 cracks not exceeding 1/4 inch in length and spaced at least 1/2 inch apart.

(3) Replace inner connectors having cracks exceeding the above limits.

d. Inspect connector for cracks in the scoop (2). Replace inner connectors having cracks in the scoop.

e. Inspect for cracked tabs (4). Replace connectors having cracked tabs.

f. Inspect for burned metal (figure 4–52) on the aft end (1) of the tube as follows:

(1) Accept one burn not exceeding 1/16 inch deep and 1/2 inch long in any 180 degrees (3).

(2) Repair one burn not exceeding 1/8 inch deep and 1/2 inch long in any 180 degrees.

(3) Replace inner connectors with burns exceeding the repairable limits.

g. Inspect the flange mating surface (7) for flatness, using a surface plate and a feeler gage. Accept flange mating surfaces flat within 0.016 inch. Repair the flange mating surface if this limit is exceeded, provided a minimum of 0.110 inch thickness can be held after re-surfacing.

h. Inspect the tube skirt for dents and bends as follows:

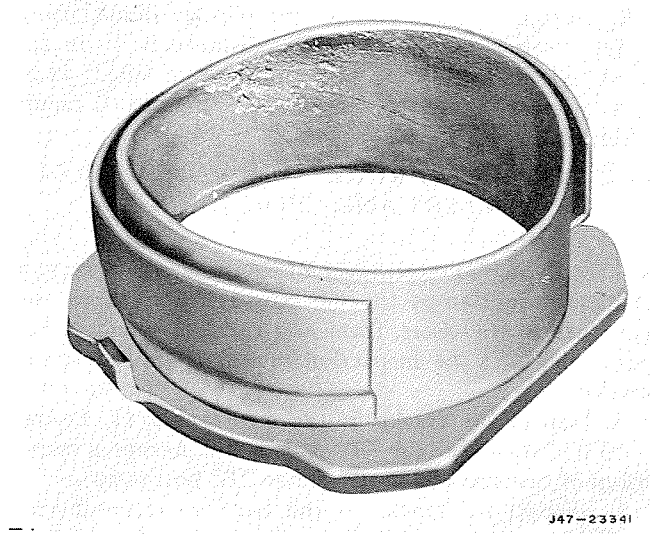


Figure 4–52. Inner Connector Beyond Repair (Burned Metal)

(1) Accept the connector without repair, provided the distance between the tube (6) and the scoop (2) is not less than 1/16 inch.

(2) Repair the connector if the distance between the tube and scoop is less than 1/16 inch.

i. Inspect for missing or mutilated tabs (4). Replace the connector if tabs are mutilated or missing.

4–119. REPAIR.

Note

Accomplish weld repairs on the inner connector using the inert arc process. Use inconel filler rod, Specification MIL–R–5031, Class 8A. Hold weld bead height to a minimum to avoid unnecessary grinding.

a. Weld repair spot welds cracked beyond the acceptable limits, using the inert arc process. Dress weld bead height flush to 0.020 inch above the parent metal.

b. V-groove cracks in tube within the repairable limits of paragraph 4–118c, and fill with weld. Dress welds flush to 0.020 above the parent material.

c. Repair burns on the aft end of the tube not exceeding 1/8 inch deep and 1/2 inch long in any 180 degree as follows:

(1) Grind away all burned metal.

(2) Build up with weld to above the original height.

(3) Dress welds to the original contour and height.

d. Straighten and resurface flange mating surfaces not flat within 0.016 inch. When resurfacing, remove the minimum amount of material to obtain the required flatness. The minimum allowable flange thickness is 0.110 inch.

e. V-groove cracks in flange to tube weld and fill with weld.

f. Straighten bent scoops and remove dents, using an applicable tool, to bring the distance between the tube body and the scoop to a minimum of 0.0625 inch.

g. Visually re-inspect connectors subjected to repair welding.

4–120. CLAMPING RINGS (FOR COMBUSTION CHAMBERS AND CROSS-IGNITION TUBES).

4–121. INSPECTION AND REPAIR. Visually inspect the marmon clamps for the cross-ignition tubes and combustion chambers, front and rear, for damage. Replace clamp if the inspection or repair limits are exceeded.

a. Inspect for cracks in the spot welds (1, figures 4–53 and 4–54) at the "T" bolt strap. Accept a maximum of one cracked spot weld at "T" bolt strap.

b. Inspect for cracks in the band to channel spot welds (1, figure 4–55). Accept one cracked spot weld per each channel segment.

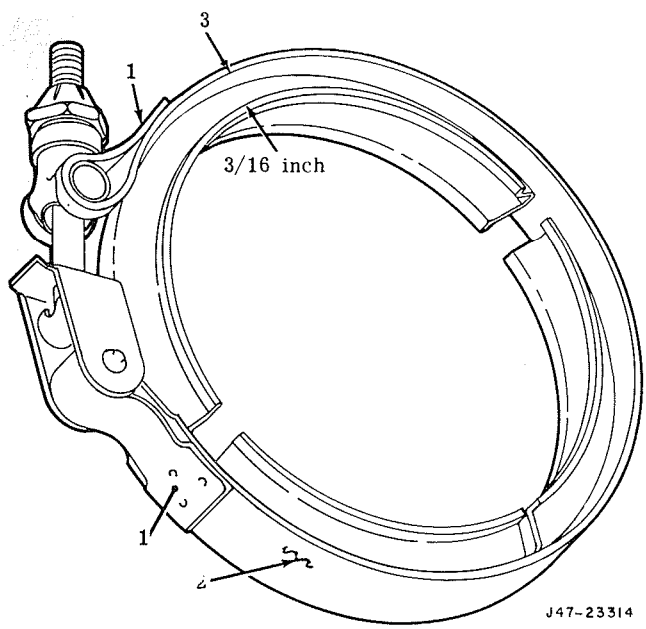
c. Inspect for cracks in the parent metal of the band (2, figures 4–53 and 4–54) and channels. No cracks are acceptable or repairable.

d. Inspect the clamp assembly for nicks and dents.

(1) Blend out damage in clamp band (2, figure 4–55) not to exceed 3/16 inch in depth and 1-1/2 inches in width. The minimum width for blends is 3/8 inch in depth. Accept one maximum blend or a combination of blends totaling one maximum blend.

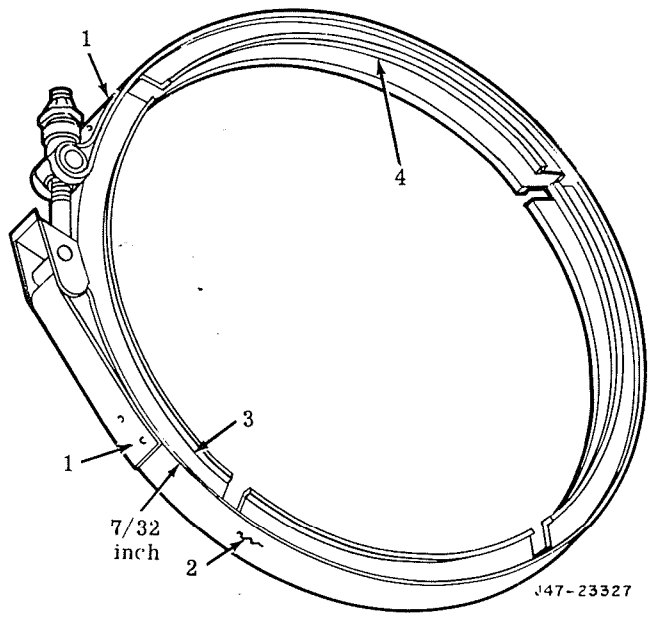
(2) Accept nicks and scratches on clamp channels not exceeding 1/64 inch in depth after removal of high metal.

(3) Replace the clamp if channels are dented.



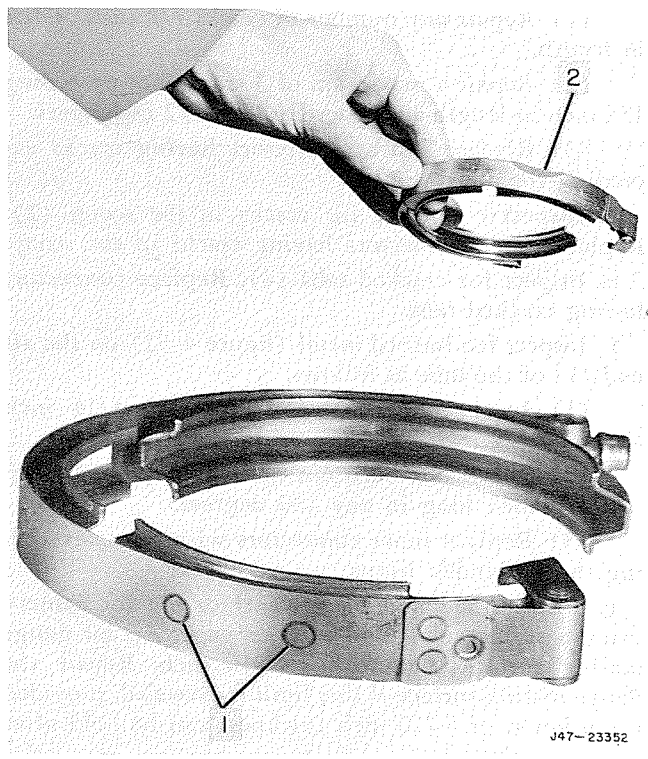
1. Spot Welds
2. Cracks in Parent Metal
3. Channel

Figure 4–53. Inspection Location for Clamping Ring (Cross-Ignition Tube)



1. Spot Welds
2. Crack in Parent Metal
3. Radial Distance between Clamp and Channel
4. Channel

Figure 4–54. Inspection Locations for Combustion Chamber Clamping Ring



1. Spot Welds
2. Dent in Clamp

Figure 4–55. Clamping Ring (Repairable Damage)

e. Inspect for distortion of the "T" bolt strap as follows:

Note

Distortion is most prevalent within 1-1/2 inches at each end of the "T" bolt and nut of the clamps.

(1) Accept distortion of cross ignition clamp if the radial distance between the strap and inner flanged portion of the "V" segment is not less than 3/16 inch (3, figure 4-53).

(2) Accept distortion of combustion chamber clamp if the radial distance is not less than 7/32 inch (3, figure 4-54).

f. Inspect clamps for heat discoloration. Accept discoloration that does not extend into the metal.

g. Inspect for damaged "T" bolt threads. Accept minor damage to the threads which does not interfere with assembly and torquing of the "T" bolt nut. Replace the "T" bolt with a new or serviceable part, if damage to the threads is excessive.

4-122. OUTER COMBUSTION CHAMBER ASSEMBLY.

4-123. INSPECTION. The outer combustion chamber will be given a careful visual inspection for damage. (See figure 4-56.)

a. Inspect for cracks in the shell of the chamber (Areas A and B). Repair cracks not exceeding one inch length and spaced at least 3 inches apart.

b. Inspect for cracks in the cover over the bellows (Area C). Replace the chamber if there are cracks in the bellows cover.

c. Inspect for cracks around the chamber drain boss (1) with the drain tube fitting assembly removed. Repair cracks in this area.

d. Inspect for circumferential cracks around the neck of the elliptical cross ignition flange (2). Repair cracks provided the total accumulative length of cracks is not more than 1/2 the circumference of the flange neck.

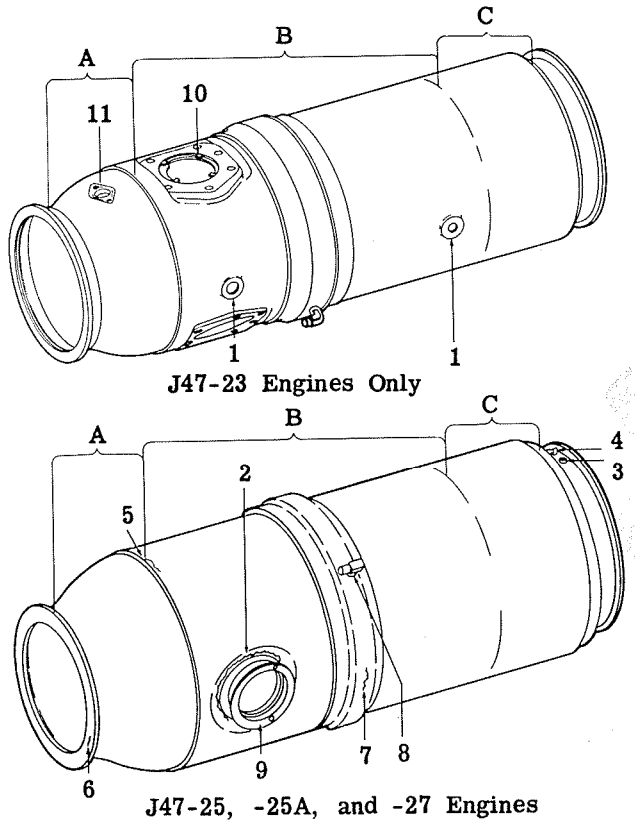
e. Inspect for cracked alignment lugs (3) in the shell aft of the bellows section (3). Replace cracked lugs. If spare lugs are not available, replace the chamber.

f. Inspect for cracked lockwire tabs (4) near the alignment lugs. Tabs may be repair welded, however excessive damage may require replacement of the tabs.

g. Inspect for cracks in lug to liner weld, tab to liner weld, and aft diffuser flange to liner weld. Repair all such cracks.

h. Inspect for cracks in resistance seam welds (5). Repair cracks with an accumulated length of not more than 3 inches with the exception of cracks in the fluid injection manifold seam weld. Replace the chamber if the total accumulated crack length exceeds 3 inches or if the fluid injection manifold seam weld is cracked.

i. Inspect for cracks in the diffuser flanges (6). A cracked diffuser flange will necessitate replacement of the chamber.



1. Chamber Drain Boss
2. Cross-Ignition Flange Circumferential Cracks
3. Alignment Lug
4. Lockwire Tab
5. Seam Welds
6. Diffuser Flange
7. Fluid Injection Manifolds
8. Manifold Fitting
9. Elliptical Cross-Ignition Flange
10. Cross-Ignition Securing Nut Plate
11. Spark Plug Mounting Plate

Figure 4-56. Inspection Locations for Outer Combustion Chambers

j. Inspect the fluid injection manifold for cracks (7). Replace the chamber if cracks are evident.

k. Inspect the manifold fittings for damage (8). Refer to paragraph 4-50 for inspection and repair instructions.

l. Inspect for cracks in silver solder braze where the fittings are joined to manifold. Repair cracks.

m. Inspect for dents in areas "A" and "B" of the chamber. Dents not exceeding 1/8 inch depth are acceptable, provided mounting flanges are not affected. Remove dents exceeding 1/8 inch depth, provided dents are not sharp and metal is not creased or excessively warped.

n. Inspect for dents and distortion in the bellows area "C". Accept dents and distortion up to a depth of

1/16 inch, provided the base of the dents or distortion has smooth contour and movement of the bellows section is not restricted. Remove dents exceeding 1/16 inch but not exceeding 3/32 inch in depth, provided dents have smooth contour.

o. Inspect for nicks and scratches in shell, areas "A" and "B". Accept minute scratches without repair. Repair nicks spaced at least one inch apart.

Note

Metal thickness of shell is 0.025 inch nominal.

p. Inspect for distorted elliptical cross-ignition flanges (9). Flanges not severely distorted will be straightened to within 0.030 inch flatness.

q. Inspect bellows type cross-ignition tube nut plate (10) for broken securing tabs. Replace the chamber if tabs are broken.

r. Inspect the diffuser flanges (front and rear) for scores, nicks, grooves, and scratches. Accept any number of scores, nicks, scratches and grooves not exceeding 0.010 inch in depth and not forming a continuous pattern across more than 3/4 of the flange seating surface after all high metal has been removed. Repair front flanges that are not flat within 0.010 inch, and rear flanges that are not flat within 0.015 inch, provided that the flange thickness does not become less than 0.120 inch.

s. Inspect the diffuser flanges (front and rear) for flatness with a surface plate and feeler gage. Front flanges flat with 0.010 inch and rear flanges flat within 0.015 inch are acceptable. Repair flanges as indicated in step "r" above.

t. Inspect for mutilated screw hole in spark plug mounting plate (11). Repair mutilated screw holes.

u. Inspect for bluish or bronze discoloration appearing on the surface of the outer chamber. Check discolored areas using fine steel wool or crocus cloth, to determine if metal is burned or if discoloration is only surface deep. Accept the chamber if discoloration is only surface deep. Replace the chamber if discoloration extends into parent metal.

v. Inspect the fluid injection manifold (J47–25 and –25A engines) for nicks and dents. Replace chamber if manifold exhibits nicks, gouges, or any sharp indentations. Accept dents without repair, provided the manifold has not been collapsed more than 1/2 its inside area (half the area is equal to 1/8 inch in depth from the outer manifold surface), or more than 2-1/2 inches in length, or if the dented area is not over one of the jet openings. Replace the chamber if damage to the fluid manifold exceeds these limits.

4–124. REPAIR.

Note

Accomplish all repair welding using the inert arc process (AMS Spec. No. 5680 filler rod) unless otherwise specified.

a. Repair cracks in shell of liner, within repair limits of paragraph 4–123a, by filling the crack with weld and benching the welded section to conform to original contour, or by cutting out the metal around the crack and patching with a piece of 1/32 inch type 347 or 321 stainless steel. The patch should overlap the hole by 3/8 to 1/2 inch and be seam welded using resistance welding equipment. Inert arc fillet welding may be used, if resistance welding equipment is not available. If the hole can be rounded, the inert arc process may be used to butt weld a patch fitted inside the hole.

b. Repair weld and bench flat any cracks in drain boss. If drain boss is excessively cracked and facilities are available, the drain boss may be cut from the chamber and a patch, material Specification AMS 5510, 1/32 inch thick may be welded on the outside of the chamber. The patch should be of sufficient diameter to extend approximately 1/2 inch beyond the embossed area, and should be welded around the outer diameter. Reform patch to the original contour of the drain boss. If the drain boss is excessively cracked and facilities are not available for patching, replace the chamber.

c. Weld cracks around neck of the elliptical cross-ignition flange and bench to a maximum height of 1/32 inch.

d. Straighten distorted elliptical type cross-ignition flanges using a suitable backing plate and ding hammer. (See figure 4–57.)

e. Mutilated ignitor plug mounting plate screw holes will be filled with weld, redrilled, and tapped to 0.250 inch 20 NC–2.

f. Broken spot welds on ignitor plug mounting plates may be repaired by re-spot welding beside broken spot weld. If spot welding facilities are not available, drill broken spot weld and fill with weld, using the inert arc process.

g. Remove rejected alignment lugs and replace with a serviceable lug. Weld lug to the chamber, using the inert arc process.

h. Cracked lockwire tabs may be welded. If damage is extensive, grind off tab and replace, using either resistance or inert arc welding equipment.

i. Use a suitable tool to remove dents and distortion in area "A" and "B" of the chamber. (See figure 4–56.)

Note

Hammering on chamber will be held to a minimum.

j. Dents in the skirt over the bellows can be removed by fusing a welding rod at the base of the dent and pulling the rod to remove dent. Cut off rod and bench flush.

Note

Dents removed by this method must be free of sharp bends.

k. Fluid injection manifolds are of 2 types. One has an eyelet for installation of the elbow fitting. The other has only a hole for elbow fitting installation. Fittings are joined to manifolds by either silver brazing or weld-

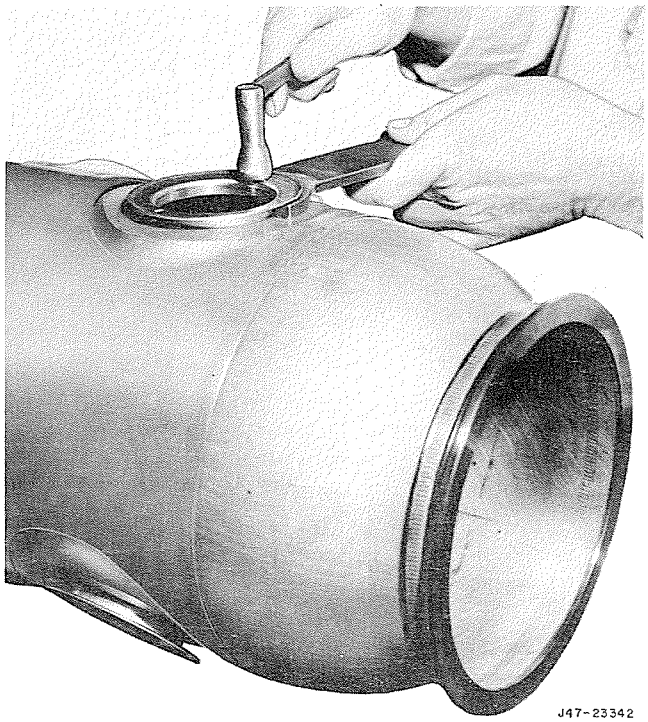


Figure 4–57. Straightening Elliptical Flange

ing. The following instructions describe both types of manifolds.

(1) Grind out cracks in brazed joints and rebraze using silver solder, Federal Specification QQ–5–561, or equivalent. Grind out cracks in welded joints and reweld using process and filler rod specified in Table VIII.

(2) If the elbow fitting on the manifold having the eyelet is damaged or missing, replace the fitting using the original part (GE P/N 9482062). Before installing the fitting, remove all braze material from the eyelet area. Weld the fitting to the manifold using process and filler rod specified in Table VIII.

(3) If the eyelet has been damaged so that fitting (GE P/N 9482062) cannot be properly installed, cut the eyelet flush to 1/32 inch above the outer manifold surface and install elbow fitting (GE P/N 303D121P3). (See figure 4–57A.) If the area around the eyelet has been damaged, or if the hole diameter is larger than 15/32 inch, the hole may be repaired by patching. Cut the eyelet flush with the outer manifold surface. Prepare a patch from 321 stainless steel to the dimensions specified in figure 4–57B. Weld the patch to the manifold, locating the holes as specified on applicable part drawings. Install elbow fitting (GE P/N 303D121P3) and fillet weld it to the patch.

(4) If the elbow fitting on the smooth manifold is damaged or missing, replace the fitting using the original part (GE P/N 303D121P3). Fillet weld the fitting to the manifold as shown in figure 4–57A. If the area around the fitting hole is damaged, it may also be patched as specified in item 3 above. (See figure 4–57B).

(5) Pressure test at 200 psig after repairs have been completed. (See figure 4–58.)

l. Resurface diffuser flanges exhibiting damage exceeding the limits of paragraph 4–123r, by any suitable method. Lapping with a flat plate and a fine grade of emery cloth is recommended.

m. Fill nicks and gouges in areas "A" and "B" (figure 4–56) with weld and bench flush to 0.010 inch above the surrounding outer surface.

n. Visually re-inspect combustion chamber assemblies subjected to repair welding to determine evidence of cracks.

4–125. LINER ASSEMBLY (INNER COMBUSTION CHAMBER).

4–126. INSPECTION. (See figure 4–59.) Visually inspect the inner combustion chamber to designated limits to determine their serviceability.

a. Inspect for cracks under the deflector or dome cap in the inner dome of area "A" as follows:

(1) Accept any number of cracks up to 1/4 inch in length without repair, provided cracks are not progressing so that a section of the liner may eventually break out.

(2) Accept 4 cracks (1) not exceeding 1/2 inch in length without repair; provided cracks are spaced at least one inch apart.

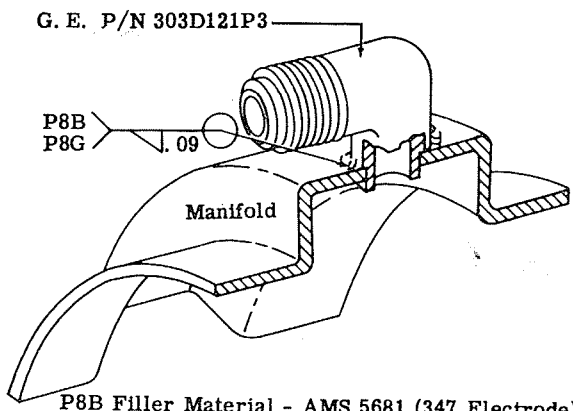


Figure 4–57A. Fluid Injection Manifold Eyelet Repair

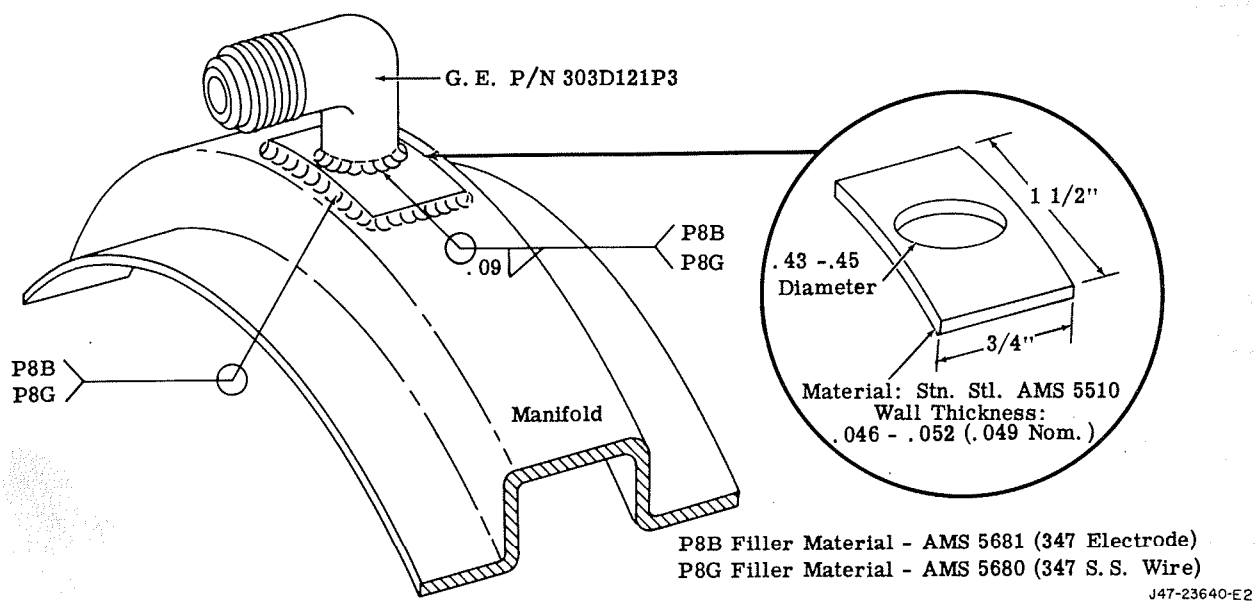


Figure 4-57B. Patch Repair, Fluid Injection Manifold

(3) Accept cracks extending from the salt shaker fix holes (2) without repair, provided total accumulated length of cracks extending from one hole does not exceed 3/8 inch and adjacent holes are free of cracks. If liners have deflector tabs at the salt shaker holes, inspect them for cracks. Remove the tab deflector tab if cracks are noted.

(4) Accept two 1/8 inch long axial cracks spaced at least 90 degrees apart in the fuel nozzle opening flange (4).

(5) Repair cracks exceeding the acceptable limits if burning has not reduced the material's original characteristics to negligible proportion or if thickness of metal has not been reduced more than one-half.

Note

Burned metal has the typical ragged edge appearance caused by melted globules of metal and granular separation in metal. Be careful not to confuse carbon deposits with burned metal. A crack in an area which has bulged (in or out) will separate, and the edges of the crack will look burned. Cleaning of edges with a wire brush will show up any actual burning. A light tap with a small ball peen hammer will usually cause a profusion of cracks in burned metal.

b. Inspect for cracks in the outer dome (cover) (3) of area "A". Accept a maximum of 2 cracks not exceeding 3/8 inch in length and spaced a maximum of one inch apart, after stop drilling. Repair weld cracks exceeding these limits.

c. Inspect for cracks in area "B" as follows:

(1) Accept a maximum of 2 cracks (5) not exceeding 1/2 inch in length and spaced a minimum of 2 inches apart, after stop drilling.

(2) Repair weld cracks not exceeding 1-1/2 inches in length.

d. Inspect for cracks in area "C" as follows:

(1) Accept cracks (6) and (15) not exceeding 1/4 inch in length.

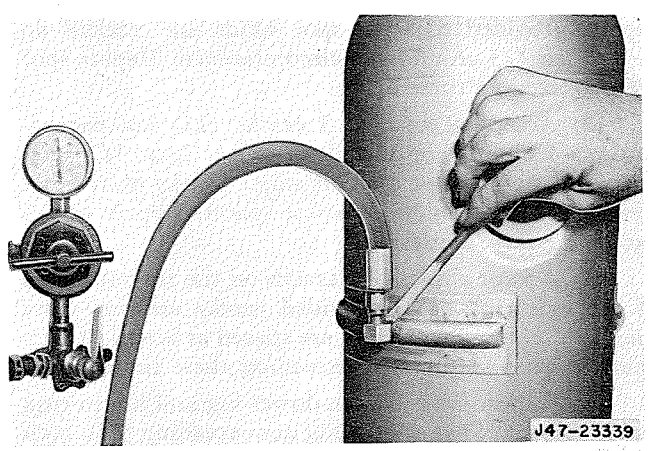


Figure 4-58. Pressure Testing Water-Alcohol Manifold

(2) Accept cracks not exceeding 1/2 inch in length after stop drilling.

(3) Weld repair cracks 1/2 inch to 1-1/2 inches maximum length.

Note

Inspector may determine when a combination of permissible cracks may endanger a section of the chamber.

(4) Accept 2 cracks not exceeding 3/16 inch in length and spaced at least 1/2 inch apart in the cross ignition eyelets (elliptical type). Repair weld cracks exceeding these limits. Weld cracks extending from adjacent louvers toward the cross-ignition eyelets (7).

(5) Accept 3 cracks not exceeding 3/16 inch in length and spaced at least 1/2 inch apart in the cross ignition eyelets of the liner using cylindrical type cross ignition system. Accept cracks in liner metal under the scoop pad without repair. Weld repair cracks extending from under the pad.

(6) Accept a maximum of 2 cracks in the scoop at least 1/2 inch apart and not more than 1/4 inch in length without repair. Weld repair cracks exceeding these limits.

(7) Accept 2 spot welds (8) broken free on any one scoop without repair, provided they are not adjacent. Repair weld spot welds cracked beyond the acceptable limits.

e. Inspect for cracks in area "D" as follows:

(1) Accept in the rear unlouvered area, a total of 3 cracks (9) not exceeding 3/8 inch in length after stop drilling. The cracks must be spaced at least twice the length of the longer crack. Weld repair cracks exceeding these limits provided they are spaced a minimum of 1/2 inch apart.

(2) Repair or replace cracked button (10).

(3) Repair cracked spot welds on buttons.

f. Inspect for cracked spot welds on the exit ring assembly, or on the castellated seal support, if used.

(1) Accept any number of spot welds cracked a maximum of 1/2 around the circumference without repair, provided adjacent spot welds are cracked no more than 1/3 around the circumference. Repair spot welds exceeding these limits.

(2) Accept a total of 3 cracks (12) not exceeding 1/2 inch in length and spaced at least 1/2 inch apart on rear edge of the exit ring. Cracks must be at least 1/2 inch from the nearest spacer. Repair cracks exceeding these limits.

(3) Accept a total of 3 cracks on the forward edge of the exit ring (13), provided cracks are not more than 1/4 inch in length and are spaced at least 1/2 inch apart. Repair weld cracks exceeding these limits.

(4) Inspect for cracks in dowel lug and lug to ring weld. Accept two cracks in lug not exceeding 3/16 inch in length, if cracks are spaced at least 90 degrees apart. Accept one crack in weld not exceeding 3/16 inch in length. Accept all cracks in weld not exceeding 1/8 inch in length, if total length of cracks does not exceed 3/8 inch. Weld cracks exceeding these limits.

(5) If the castellated seal (14) is cracked or missing, replace with a new or serviceable seal.

Note

Whenever spare sub-assembly parts are not available, replace the complete inner chamber assembly.

g. Inspect for wear in the following areas.

(1) Accept cross-ignition eyelets (elliptical and cylindrical type) worn to a minimum thickness of 0.020 inch. Repair weld eyelets worn beyond this point.

(2) Accept worn buttons (10) to a minimum thickness of 0.020 inch. Repair weld wear beyond this point.

(3) Accept dowel pin lugs worn to a minimum thickness of 0.065 inch. Repair weld or replace lugs worn beyond this point.

(4) Accept fuel nozzle inserts and fuel nozzle flanges worn to a minimum thickness of 0.015 inch. Repair weld inserts or flanges worn beyond this point.

h. Inspect for dents and bulges as follows:

(1) Accept dents and bulges in area "A" under the dome cap to a maximum of 1/2 inch above or below the original contour, provided the fuel nozzle holes are not affected.

(2) Accept dents and bulges in areas "B" and "C" to a maximum of 1/2 inch above or below original chamber contour provided there are no cracks in the buckled area and the combustion gases are not directed through the side of the inner chamber.

(3) Accept dents and bulges in the forward section of area "D" extending to the face of the exit ring to a depth or height of 1/2 inch.

4–127. REPAIR.

a. Accomplish all welding on the inner liner with the inert arc process using inconel rod, Specification MIL–R–5031, Class 8A. Blend welds flush to 1/32-inch above the parent metal with edges blended into the parent material.

b. Use a 1/16 inch drill for stop drilling. Stop drill all cracks to be welded.

c. Remove over limit dents and bulges using a ding hammer, hydraulic forming fixture, or other suitable method.

KEY TO FIGURE 4–59 →

1. Inner Dome Cracks
2. Salt Shaker Fix Hole Cracks
3. Dome Cover Cracks
4. Fuel Nozzle Flange
5. Lower Dome Cracks
6. Louver Area Cracks
7. Cross-Ignition Eyelet Area Cracks
8. Scoop Spot Welds
9. Rear Unlouvered Area Cracks
10. Spacers (Buttons)
11. Dowel Pin Lug Cracks
12. Exit Ring Cracks (Rear)
13. Exit Ring Cracks (Front)
14. Castellated Seal
15. Inner Liner Shell

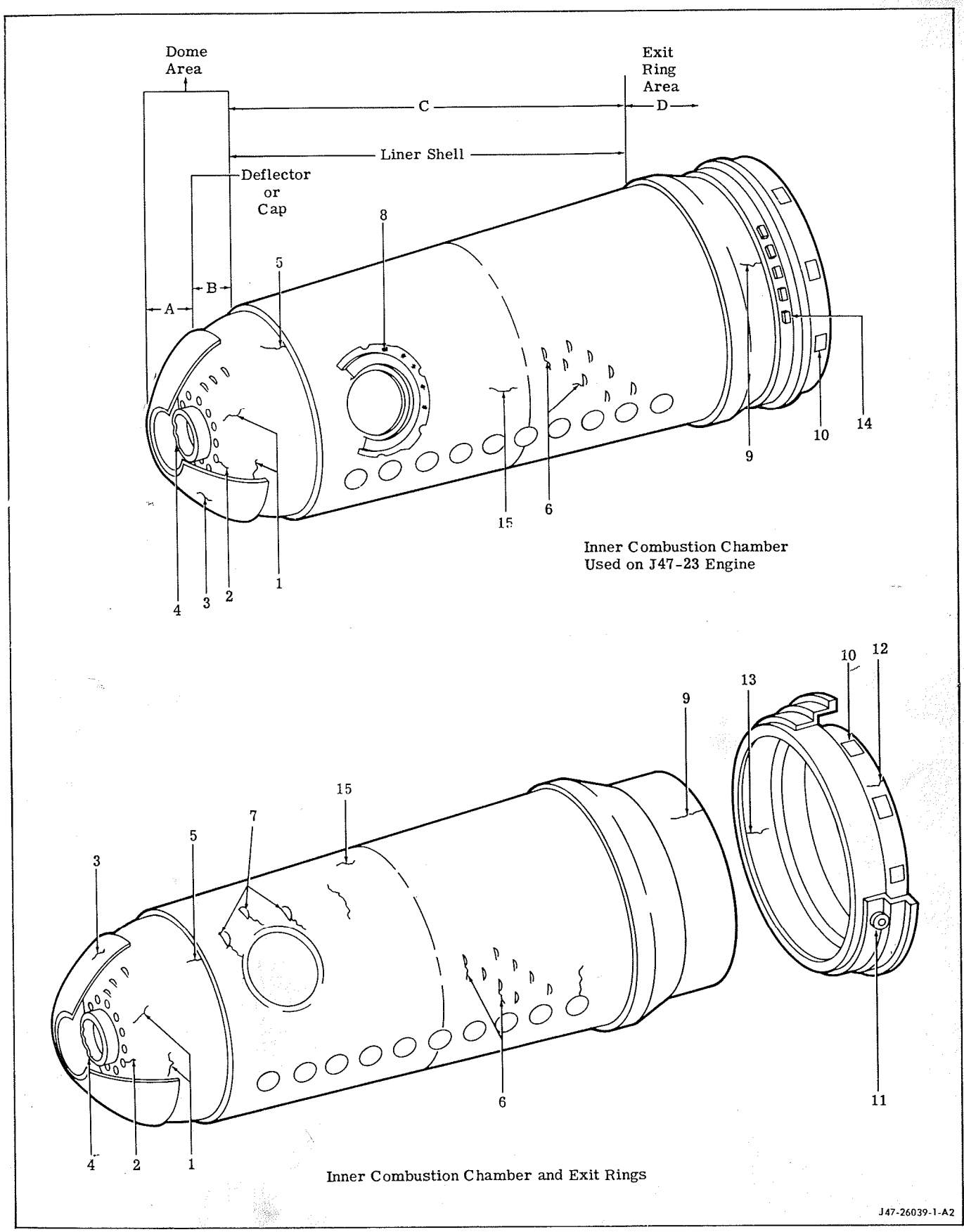


Figure 4-59. Inspection Locations for Inner Combustion Chamber

d. Build up worn buttons, lugs, cross ignition eyelets, fuel nozzle inserts and fuel nozzle flanges with weld. Grind welded areas to acceptable thicknesses. Damaged fuel nozzle inserts may be replaced, rather than repaired, if parts and facilities are available.

e. The dome cap may be removed to perform repairs to the dome section.

f. Repair spot welds cracked beyond the acceptable limits by welding with the inert arc process.

g. Re-inspect visually inner combustion chambers subjected to repair welding.

4–128. TRANSITION LINER ASSEMBLY. (See figure 4–60.)

4–129. INSPECTION AND REPAIR. Inspect transition liners for cracks, bulges, wear, and other damage. Repair as specified.

a. Inspect the shell of the liner for cracks. If there are cracks in the shell, replace the transition liner, except as follows:

(1) Accept 3 cracks not exceeding 3/16 inch length and spaced at least 1½ inches apart emanating from the corner or outer aft edge of the liner (1) and extending forward. Repair weld 3 cracks exceeding 3/16 inch length but not exceeding 1½ inches in length and spaced at least 1½ inches apart.

(2) Accept 3 cracks not exceeding 3/16 inch length and spaced at least 2 inches apart in the concentric forward end of the liner (2). Repair weld 3 cracks exceeding 3/16 inch length but not exceeding one inch length and spaced at least 2 inches apart.

(3) Accept no cracks in the aft curvature side (3). Repair weld 2 cracks in each aft curvature side not exceeding one inch length and spaced at least one inch apart. Repair weld one crack in each aft curvature side not exceeding 1½ inches long. The seam weld in this area is included in this repair.

b. Inspect liner for cracks in the seam weld (4). Replace the liner if the seam weld is cracked.

c. Inspect and repair the outer support bracket as follows:

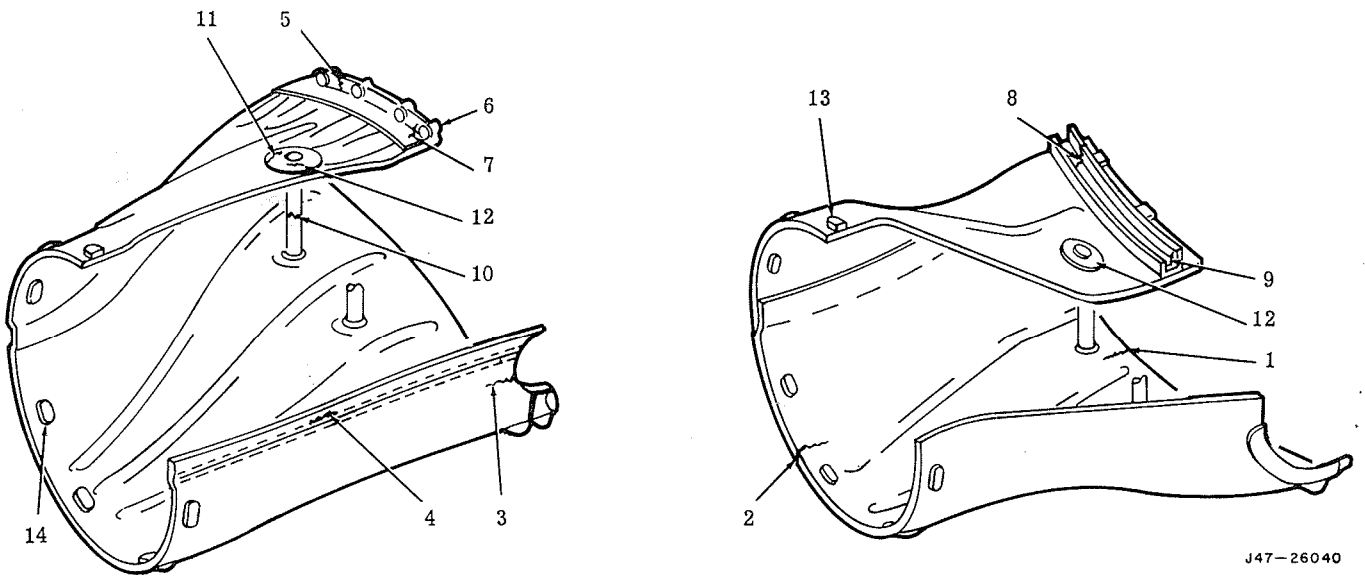
(1) V-groove and weld cracks in the outer bracket (5) if cracks are spaced at least one inch apart.

Note

Repair weld on the transition liner with the inert arc process, using inconel rod, AMS 5683 (U. S. A. F. Specification No. MIL–R–5031, Class 8A).

(2) Replace cracked, missing, or distorted alignment pins (6). Drill the old pin from the bracket and install a serviceable pin, holding it in place with alignment wire through the pin holes. Weld on the back side. Replace the liner if spare pins are not available.

(3) Inspect for broken spot welds on the outer bracket (7). Spot welds at ends of bracket must be



1. Outer Aft Edge Cracks
2. Forward Edge Cracks
3. Aft Curvature End Cracks
4. Seam Weld Cracks
5. Outer Bracket Cracks
6. Alignment Pins
7. Outer Bracket Spot Welds
8. Inner Support Bracket Cracks
9. Inner Support Bracket Spot Welds
10. Cracked Support Tubes
11. Stiffener Plate Cracks
12. Support Tube Fillet Weld Cracks
13. Outer Spacers (Buttons)
14. Inner Spacers (Buttons)

Figure 4–60. Inspection Locations for Transition Liners

free of cracks. Accept cracks in the other spot welds, provided adjacent spot welds are free of cracks. Drill out cracks exceeding the above limits and fill with weld, provided there are not more than 3 spot welds requiring repair. Bench weld to the original contour.

(4) Inspect the outer bracket for distortion. Accept distortion in the outer bracket, provided the transition liner will assemble properly. If liner cannot be assembled because of distortion in the outer bracket, remove the distortion if facilities are available. Replace the liner if facilities are not available.

d. Inspect and repair the inner support bracket as follows:

(1) V groove and weld a maximum of 4 cracks, provided cracks are spaced at least one inch apart and do not protrude into the parent metal (8). Bench weld to the original contour.

(2) Inspect and repair spot welds on the inner support bracket (9) as outlined in step c (3) above.

(3) Inspect the inner support bracket for distortion. Repair distortion, unless severe, by using a suitable fixture and alignment tool. (See figure 4-61.)

e. Inspect the support tubes for damage as follows:

(1) Replace cracked or burned support tubes (10). Drill or grind defective support tube from the liner. Place serviceable tube in position and fillet weld both ends. If replacement tubes are not available, replace the transition liner.

(2) Replace the liner if there are cracks in the support tube stiffener plate (11), or in the metal under and around this plate.

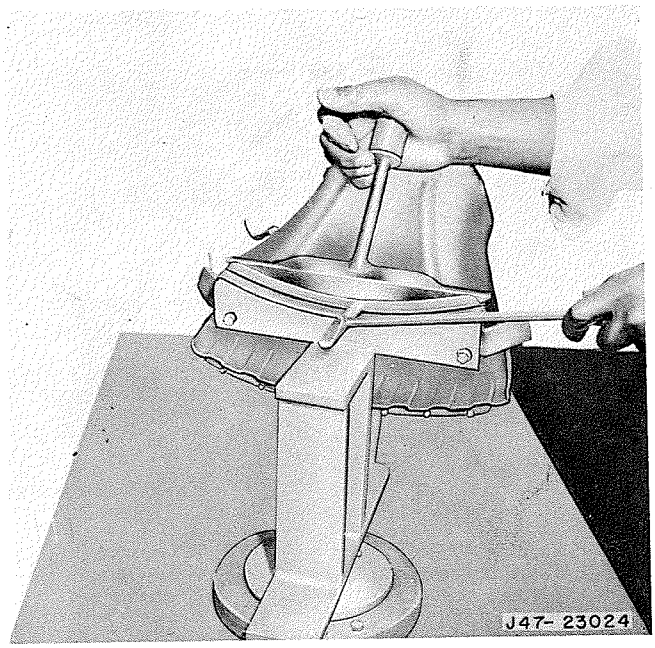


Figure 4-61. Correction Distortion on Inner Support Bracket

(3) Grind out cracks in the fillet weld at the base of the support tube (12) and fill with weld.

(4) Inspect support tubes for bending. Replace tubes with bending in excess of 1/8 inch.

f. Inspect for cracked, worn and missing buttons (13 and 14).

(1) V-groove and weld cracked buttons.

(2) Accept outer buttons worn to a minimum material thickness of 0.060 inch. Build up with weld buttons worn beyond this limit and grind to a thickness of 1/8 inch.

Note

Diameter at outer buttons must not exceed 8.130 inch.

(3) Accept inner buttons worn to a minimum material thickness of 0.020 inch. Build up buttons worn beyond this limit with weld and grind to a thickness of 0.035 to 0.050 inch.

(4) Replace missing buttons by spot welding or welding around edge using the inert arc process. If serviceable spare buttons are not available, replace the transition liner.

g. Inspect the shell of the liner for hot spots, nicks, dents, and distortion.

(1) Replace liners exhibiting hot spots or burned out metal.

(2) Remove dents having a maximum depth of 1/16 inch, and at least a 3/16 inch diameter for each 1/64 inch of depth with a brass hammer, or equivalent. Replace the liner if dents exceed the above limits.

(3) Replace the liner if there is distortion in the shell, except for an out-of-round condition at the forward or button end. Correct this condition by using a hydraulically operated fixture (see figure 4-62) or any other suitable method.

h. Inspect for curling or buckling on the shell lip aft of the inner support bracket (15). Curling or buckling is acceptable to 1/32 inch height, provided edges are not curled toward inside of the liner. Curling or buckling exceeding these limits may be dinged out with a brass hammer, using a suitable fixture. (See figure 4-63.)

i. Visually inspect transition liners subjected to repair welding.

4-130. ANNULAR TRANSITION ASSEMBLY.

4-131. GENERAL INSPECTION. Visually inspect the annular transition assembly (consisting of transition liner, inner and outer band) for damage.

a. The following conditions are considered beyond repair and require replacement of the transition liner, inner band or outer band.

(1) Missing sections—pieces broken out of the main structure of the component.

(2) Excessive cracking—more than the maximum limits specified in the succeeding paragraphs.

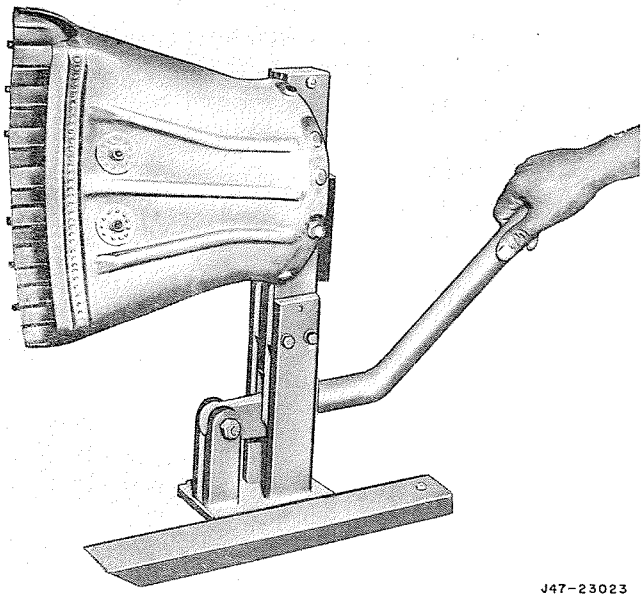


Figure 4–62. Correcting Out-of-Roundness at Forward End

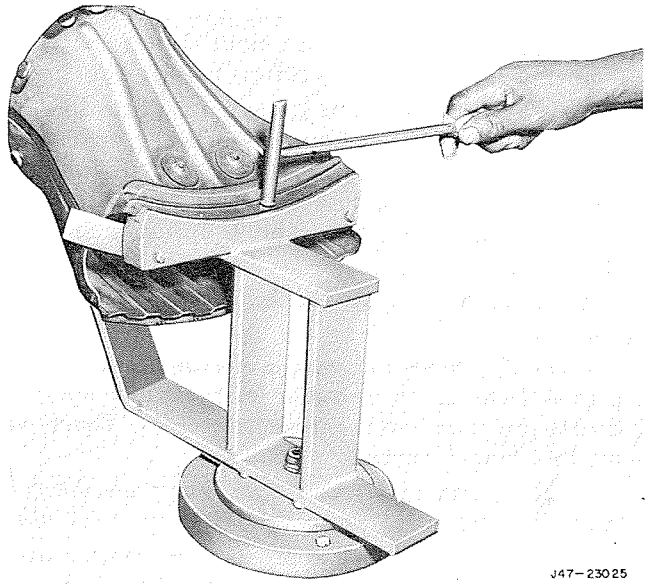


Figure 4–63. Correcting Buckling on Aft Lip

(3) Severe burning — where the strength or original characteristics of the material have been destroyed or reduced to negligible proportions.

(4) Reduction in thickness—where the thickness of the material has been reduced by more than half by wear, burning, or erosion.

(5) Severe blisters and wrinkles.

4–132. ANNULAR TRANSITION LINER.

4–133. INSPECTION. (See figure 4-64.)

a. Inspect the liner shell as follows:

(1) Accept 2 cracks *(4)* in the forward end not exceeding 1/2 inch in length and spaced at least 5 inches apart. Weld 4 cracks not exceeding one inch in length and spaced at least 2 inches apart.

(2) Accept one crack *(1)* not exceeding 1/2 inch in length in each weld joining the inner and outer halves. Weld 2 cracks not exceeding one inch in length in each weld.

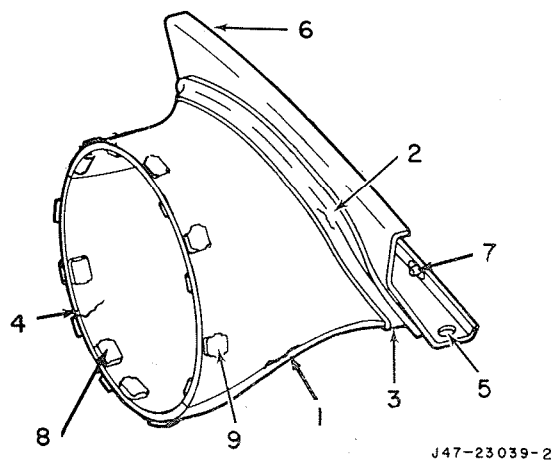
(3) Accept 2 cracks *(2)* not exceeding 1/2 inch in length and spaced at least 8 inches apart in the seam weld joining the inner and outer halves to the flange. Weld 4 cracks not exceeding one inch in length and spaced at least 3 inches apart.

(4) Weld cracked button spot welds.

(5) Accept buckling or distortion not exceeding 3/16 inch from the original contour. Repair buckling or distortion not exceeding 1/4 inch, if practical.

(6) Accept nicks and scratches not exceeding 1/2 the metal thickness in depth. Replace the liner if this limit is exceeded.

b. Inspect the flange *(3)*, channel *(5)*, and support *(6)* as follows:



1. Crack in Weld
2. Crack in Seam Weld
3. Flange
4. Crack in Forward End
5. Channel
6. Support
7. Anchor Nut
8. Inner Button
9. Outer Button

Figure 4–64. Inspection Locations for Annular Transition Liner

Note

The flange, channel, and support may be constructed as one part.

(1) Accept 2 cracks not exceeding 1/2 inch in length and spaced at least 4 inches apart in each seam weld. Weld 4 cracks not exceeding one inch in length and spaced at least 3 inches apart.

(2) Accept 2 parent metal cracks not exceeding 1/2 inch in length. Weld parent metal cracks not exceeding one inch in length and spaced at least one inch apart.

(3) Weld cracked anchor nut spot welds.

(4) Replace missing anchor nuts *(7)*. Replace the chamber if spare nuts are not available.

(5) Accept distortion not interfering with assembly of the transition liner. Remove unacceptable distortion, if practical.

(6) Accept nicks and scratches not exceeding 1/2 the metal thickness in depth. Replace the transition liner if this limit is exceeded.

c. Inspect the inner and outer buttons *(8, 9)* as follows:

(1) Replace missing buttons. If spare buttons are not available, replace the transition liner.

(2) Weld cracked buttons.

(3) Accept inner buttons worn to a minimum thickness of 0.020 inch. Build up weld if this limit is exceeded.

(4) Accept outer buttons worn to a minimum thickness of 0.040 inch. Build up weld if this limit is exceeded.

d. Replace the transition liner when damage exceeds the preceeding repair limits.

4-134. INNER BAND ASSEMBLY.

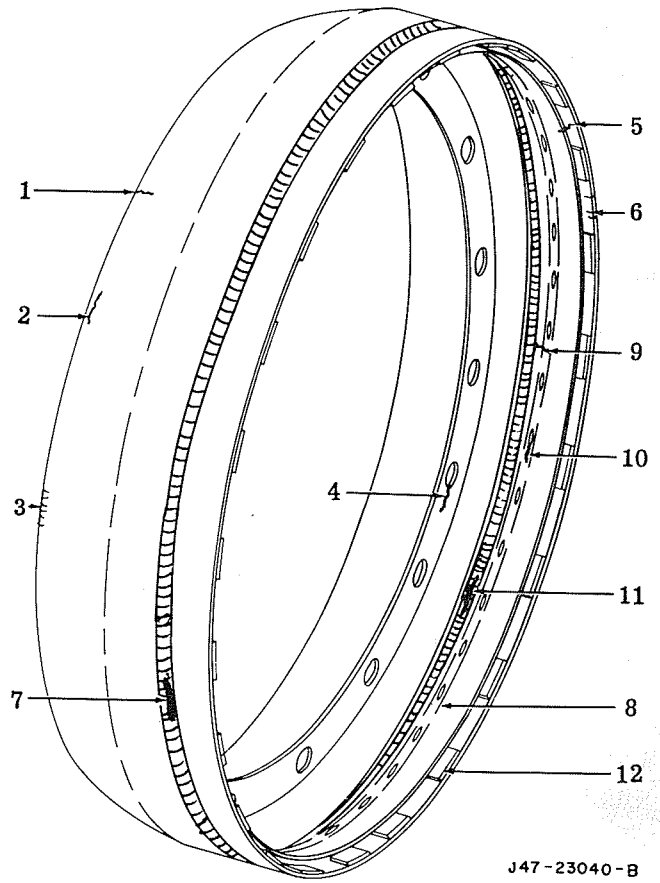
4-135. INSPECTION. (See figure 4-65.)

a. Inspect the shell as follows:

(1) Accept 3 axial cracks *(1)* emanating from the forward edge, not exceeding 1/4 inch in length, and spaced at least 8 inches apart. Repair weld 8 axial cracks exceeding 1/4 inch length, but not exceeding one inch length and spaced at least 2 inches apart.

(2) Accept 2 forward edge circumferential cracks *(2)* not exceeding 3/4 inch in length and spaced at least 6 inches apart. Weld forward edge circumferential cracks not exceeding 1-1/2 inches in length and spaced at least 4 inches apart.

(3) Accept axial, check-type cracks *(3)* on the forward end if cracks do not exceed 1/4 inch in length, are spaced at least 5/32 inch apart, and if affected areas do not exceed 2 inches total length. Replace the part if these limits are exceeded.



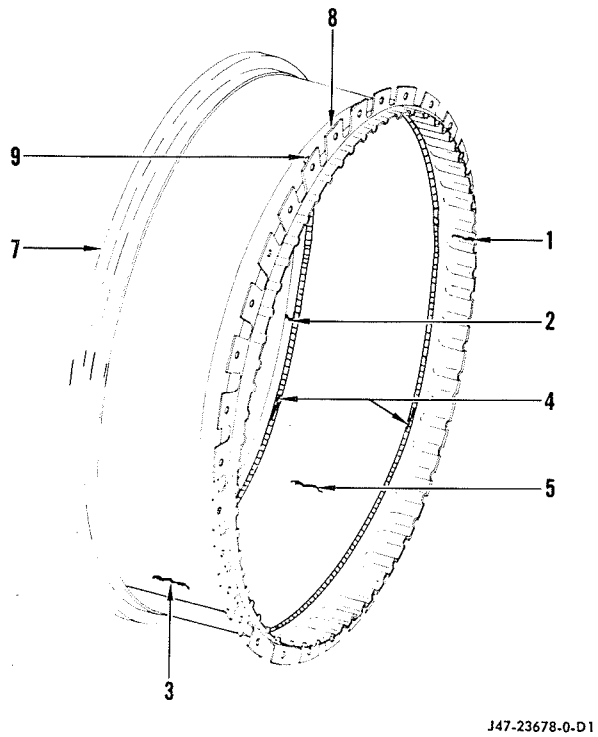
1. Axial Crack in Forward End
2. Circumferential Crack in Forward End
3. Check-Type Cracks, Fwd. End
4. Mounting Hole Crack
5. Half-Inch Crack in Rear End
6. Quarter-Inch Cracks in Rear End
7. Crack in Seam Weld
8. Seal Ring
9. Crack in Seal Ring
10. Cooling Hole Crack
11. Seal Ring Seam Weld Crack
12. Spacer

Figure 4–65. Inspection Locations for Inner Band

(4) Accept one crack *(4)* extending from each mounting hole, when the crack does not exceed 1/4 inch in length. Weld cracks extending from mounting holes, when the crack does not exceed 1/2 inch in length.

(5) Accept one crack (5) in each area between spacers not exceeding 1/4 inch in length. Repair weld cracks that exceed 1/4 inch, but that do not exceed one inch in length. Repair weld all cracks (6) not exceeding 1/2 inch in length.

(6) Accept 2 cracks *(7)* in the seam weld when the cracks do not exceed 1-1/2 inches in length and are spaced at least 10 inches apart. Weld 3 cracks not exceeding 2 inches in length and spaced at least 4 inches apart.



1. Rear End Crack
2. Forward End Crack
3. Crack in Split Line Weld
4. Cracks in Seam Weld
5. Shell Crack
6. Deleted
7. Support Ring
8. Rear Mounting Flange
9. Anchor Nut

Figure 4–66. Inspection Locations for Outer Band

(7) Weld cracked spot welds.

(8) Accept buckling and distortion not exceeding 3/16 inch from the original contour if it does not interfere with assembly. Remove buckling and distortion not exceeding 1/4 inch from the original contour.

(9) Accept nicks and scratches not exceeding 1/2 the metal thickness in depth. Replace the part if this limit is exceeded.

b. Inspect the seal ring *(8)* as follows:

(1) Accept axial cracks *(9)* extending from the edge of the ring if they do not exceed 1/8 inch in length. Weld cracks extending into but not through the seam weld if they are spaced at least 1-1/2 inches apart.

(2) Accept cracks *(10)* extending from cooling holes when they do not exceed 1/8 inch in length. Weld cracks not exceeding 1/4 inch in length.

(3) Accept 2 cracks *(11)* in the seam weld when they do not exceed 1-1/2 inches in length and are spaced at least 10 inches apart. Weld 4 cracks not exceeding 3 inches in length and spaced at least 4 inches apart.

(4) Accept minor distortion if annular band will fit on the turbine nozzle inner band. Repair excessive distortion, if practical. Replace the annular inner band if excessive distortion cannot be removed from the seal ring.

(5) Accept nicks and scratches not exceeding 1/2 the metal thickness in depth. Replace the inner band if nicks and scratches exceed this limit.

c. Inspect the spacers *(12)* as follows:

(1) Weld cracked spacers.

(2) Replace missing spacers if spare spacers are available. If spare spacers are not available, replace the inner band.

(3) Accept spacers worn to a minimum thickness of 0.020 inch. Build up spacers worn below this limit with weld.

d. Replace the inner band assembly when damage exceeds the preceding repair limits.

4-136. OUTER BAND ASSEMBLY.

4-137. INSPECTION. (See figure 4-66.)

a. Inspect the shell as follows:

(1) Accept 3 axial cracks *(1)* not exceeding 1/2 inch length and spaced at least 10 inches apart extending from the aft edge. Repair-weld all cracks exceeding 1/2 inch in length but not exceeding one inch in length, and spaced at least 3 inches apart.

(2) Accept 3 axial cracks *(2)* extending from the forward edge to the seam weld if they are spaced at least 8 inches apart. Weld 6 cracks extending to the seam weld if they are spaced at least 3 inches apart.

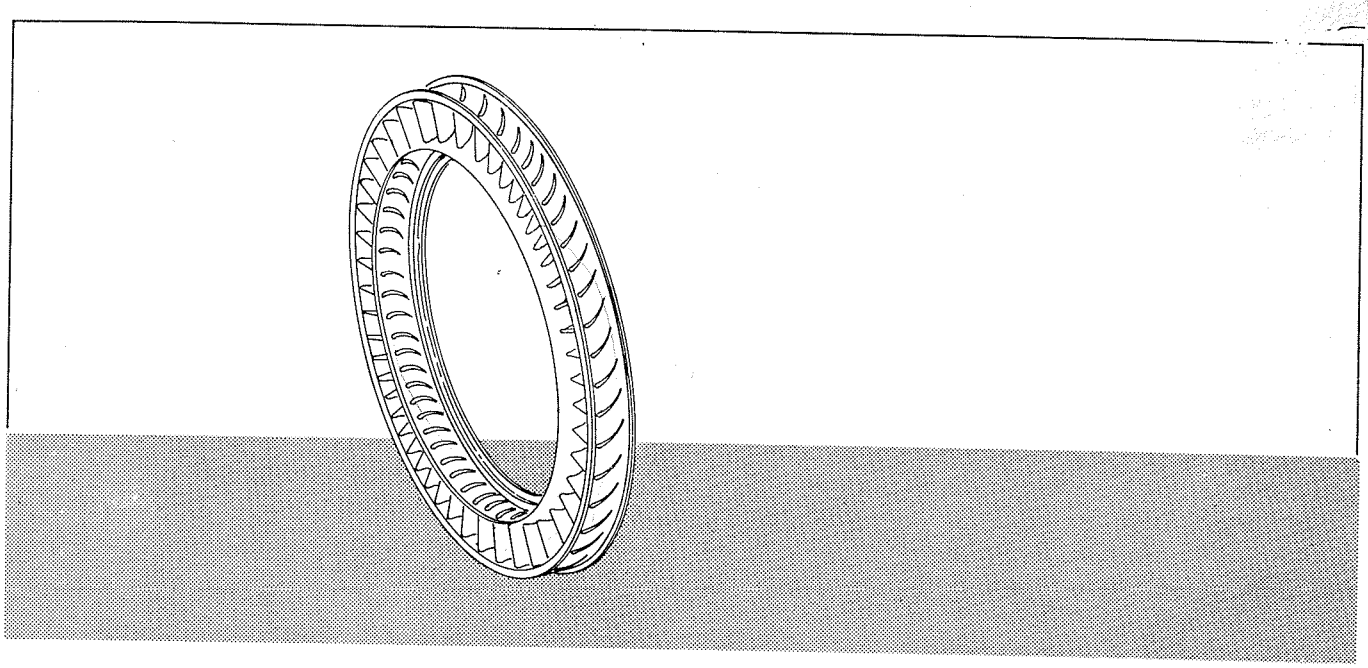
(3) Accept 3 areas of heat checking in the forward end if they do not exceed one inch in length and are spaced at least 8 inches apart. Weld minor heat checking if areas do not exceed 2 inches in length and are spaced at least 3 inches apart.

(4) Weld cracks *(3)* in the split line weld.

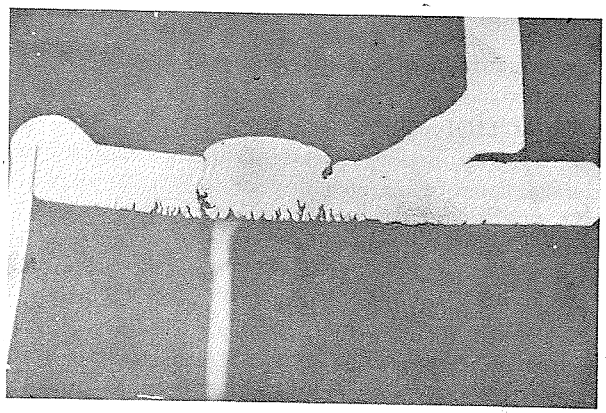
(5) Accept 2 cracks *(4)* in each seam weld when they do not exceed 1/4 inch in length and are spaced at least 6 inches apart. Weld 4 cracks not exceeding 2 inches in length and spaced at least 4 inches apart.

(6) Weld 2 cracks *(5)* in the area between the seam welds when they do not exceed one inch in length and are spaced at least 3 inches apart.

(7) Deleted.

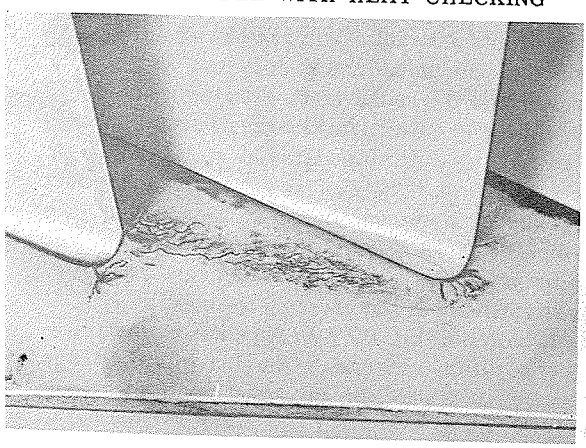


CROSS CUT OF HEAT-CHECKED SPACER BAND



TURBINE NOZZLE WITH HEAT-CHECKING

TURBINE NOZZLE WITH HEAT-CHECKING



TURBINE NOZZLE WITH MULTIPLE DAMAGE

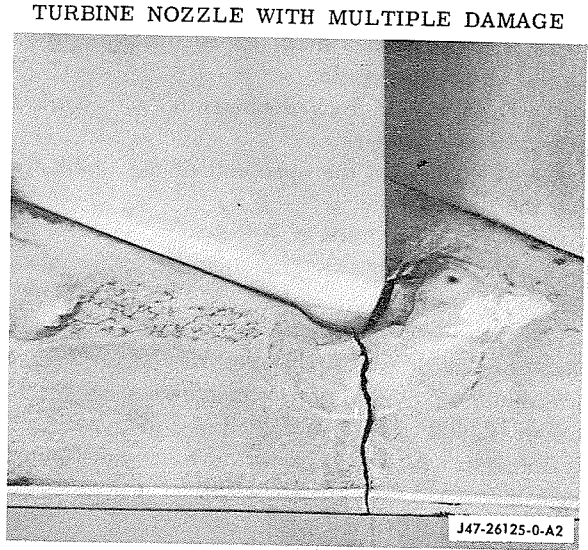


Figure 4–66A. Turbine Nozzle with Heat-Checking and Multiple Damage Beyond Repair

(8) Repair buckling and distortion of the forward and after ends, if practical. Replace the part if buckling and distortion cannot be removed.

(9) Accept buckling and distortion in the area between the seam welds not exceeding 3/16 inch from the original contour. Repair buckling and distortion exceeding this limit, if practical. Replace the part if buckling and distortion cannot be removed.

(10) Accept nicks and scratches not exceeding 1/2 the metal thickness in depth. Replace the part if this limit is exceeded.

b. Inspect the forward support ring *(7)* and aft mounting ring *(8)* as follows:

(1) Weld cracks extending to the seam welds.

(2) Accept 2 cracks in each seam weld when they do not exceed 1/4 inch in length and are spaced at least 6 inches apart. Weld 4 cracks not exceeding 2 inches in length and spaced at least 4 inches apart.

(3) Weld cracks in split-line welds.

(4) Weld cracked anchor nut spot welds.

(5) Replace missing or defective anchor nuts *(9)*.

(6) Accept minor distortion which does not interfere with assembly of the outer band of transition liner. Repair excessive distortion, if practical.

(7) Accept nicks and scratches not exceeding 1/2 the metal thickness in depth. Replace the outer band if nicks and scratches exceed this limit.

c. Replace the outer band assembly when damage exceeds the preceeding repair limits.

4-138. ANNULAR TRANSITION ASSEMBLY.

4-139. GENERAL REPAIR.

a. Weld the annular transition assembly using process and filler rod specified in table VII. Prepare cracks for full weld penetration. Blend welds to 1/32 inch above the parent metal.

b. Repair parts having cracks within the repair limits as follows:

(1) Center punch a mark approximately 1/8 inch from the end of the cracks.

(2) Drill a 1/16 inch diameter hole through the metal at the punch mark.

(3) Weld toward the open end of the crack, starting at the drilled hole.

c. Replace anchor nuts as follows:

(1) Drill spot welds from nut or from parent metal, and remove nut.

(2) Place a serviceable nut in position and fill drilled holes with weld. If holes were drilled in defective nut for removal, replacement nut may be resistance spot welded to part, or drilled and plug welded.

d. Build up with weld, transition liner inner buttons worn below 0.020 inch thickness. Resurface to a thickness of 0.035 to 0.050 inch.

e. Build up with weld, transition liner outer buttons worn below 0.040 inch thickness. Resurface to a thickness of 1.125 to 1.145 inch.

f. Build up with weld, inner band spacers worn below 0.020 inch thickness. Resurface to a thickness of 0.035 to 0.050 inch.

g. Replace missing or excessively damaged buttons and spacers, using either the inert arc or resistance welding process.

h. Remove high metal from all acceptable nicks and scratches.

i. Remove buckling and distortion using suitable sheet metal hammers and forming tools.

j. Re-inspect parts after repairs have been completed.

4–140. INSPECTION AND REPAIR OF TURBINE SECTION.

4–141. TURBINE NOZZLE.

Note

Visually inspect the turbine nozzle for burned metal, erosion and other damage that may limit the service of the part. (See figure 4–66A.) If nozzle is damaged beyond repair limits listed herein, and does not contain any damage as shown in figure 4–66A, return the nozzle to overhaul for repair. However if any of the conditions shown in figure 4–66A are evident, the turbine nozzle is beyond repair and should be scrapped.

4–142. INSPECTION OF TURBINE NOZZLE PARTITIONS. Visually inspect all turbine nozzle partitions for the defects listed below. (See figure 4–67.) Replace the turbine nozzle if partition damage is in excess of the acceptable limits, except when repair is specified.

a. Accept axial cracks ("A" and "B"), converging axial cracks ("E") and radial cracks ("C" and "D") up to one inch in length, including those which terminate at the leading or trailing edge or at the inner or outer spacer band. Accept 3 such cracks per partition, provided the distance between adjacent cracks is not less than the length of the shorter crack.

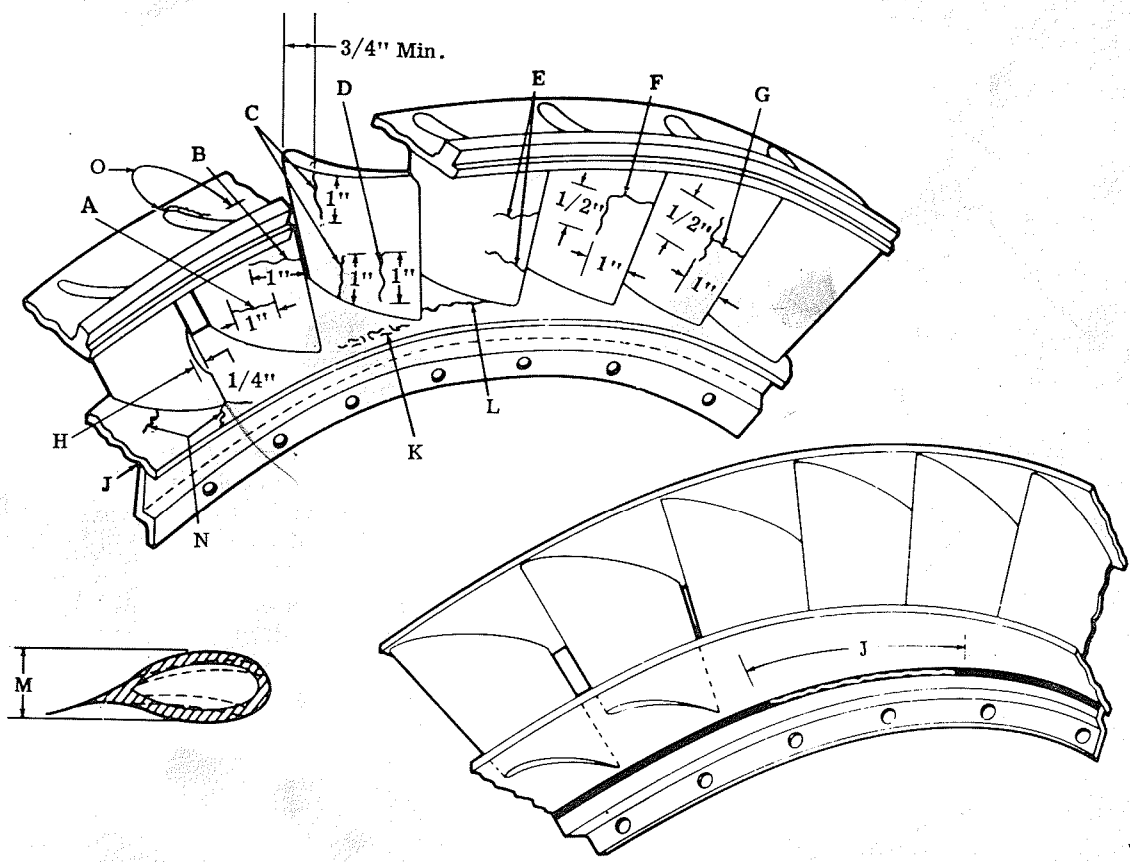
Note

Radial cracks must be a minimum of 3/4 inch from leading or trailing edge.

b. Accept combined radial and axial cracks ("F" and "G"), provided the axial crack does not exceed one inch in length and the radial crack does not exceed 1/2 inch in length. No other cracks are allowed in partitions which have one combined radial and axial crack.

c. Accept buckling ("H") of the trailing edge of a partition if the displacement does not exceed 1/4 inch and not more than 8 partitions are damaged to the maximum limit. Accept a total of 24 damaged partitions if the displacement does not exceed 1/8 inch.

d. Accept ballooning ("M") or increase in the thickness of the partition contour if the maximum change does not exceed 1/8 inch and not more than one partition in each section of 8 adjacent partitions is damaged to this maximum limit. Accept a total of 24 damaged



A. Partition Axial Cracks
B. Partition Axial Cracks
C. Partition Radial Cracks
D. Partition Radial Cracks
E. Partition Converging Axial Cracks
F. Combined Radial and Axial Cracks
G. Combined Radial and Axial Cracks
H. Buckling on Partition Trailing Edge
J. Inner Band to Mounting Flange Weld Crack
K. Inner Band Heat Checking
L. Crack from Partition Slot to Partition Slot
M. Ballooning
N. Inner or Outer Band Circumferential Cracks
O. Partition to Band Weld Cracks

Figure 4-67. Inspection Locations for Turbine Nozzle

partitions if the increase in partition contour does not exceed 1/16 inch.

e. Accept indentations found in partitions, provided they do not exceed 1/16 inch in depth.

f. Accept nicks and scratches in partitions provided they do not exceed 1/64 inch.

g. Remove unacceptable nicks, dents, and cracks in the partition within 3/16 inch of the trailing edge by grinding back the trailing edge to a maximum depth of 0.235 inch and profiling to a smooth contour. Rework a maximum of 25 partitions per nozzle assembly (see figure 4-68).

h. When damage to partitions is in excess of the preceding limits, one partition per segment up to a total of 8 partitions may be replaced. Refer to paragraph 4-146e, for partition replacement instructions.

4-143. INSPECTION OF TURBINE NOZZLE INNER AND OUTER SPACER BANDS. Inspect the inner and outer spacer bands for the defects listed below. Replace the turbine nozzle if inner and outer band damage is in excess of the repairable limits. (See figure 4-67.)

a. Accept heat checking ("K") on the inner and outer spacer bands, provided cracks have not formed in excess of 3/8 inch and cracks are not joined so that a section may break out.

b. Accept 3 axial or circumferential cracks ("N") originating at the partition slots. Cracks must not exceed 1/2 inch in length, except as follows:

(1) Accept one axial crack originating at the trailing edge of partition slots and extending over the

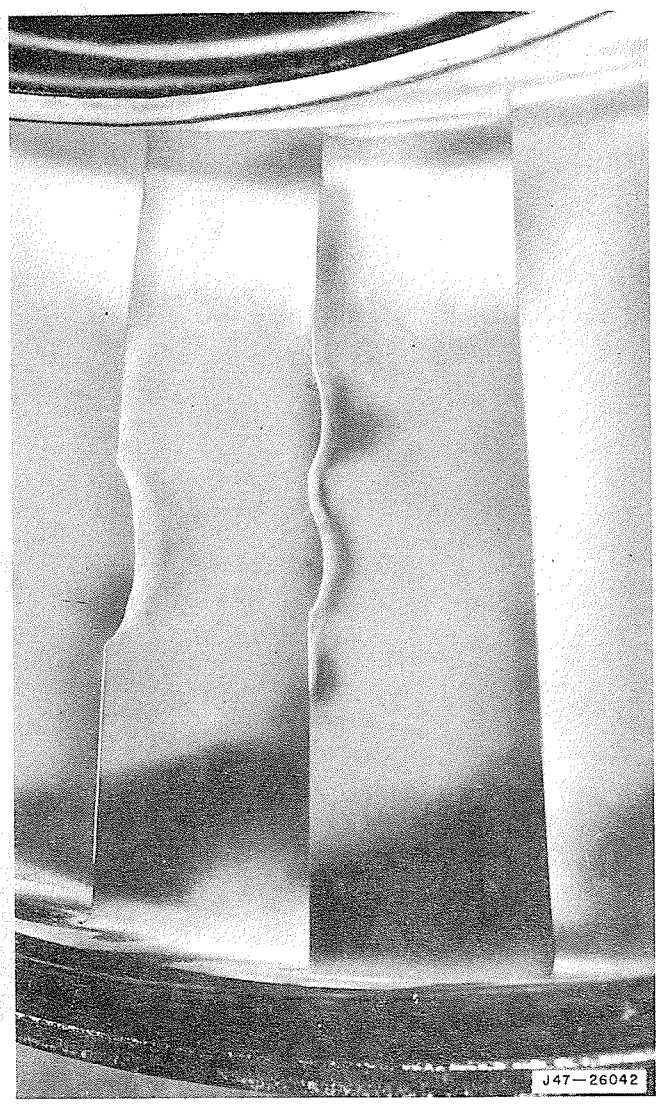


Figure 4–68. Partition Trailing Edge Repair

edge of the inner spacer band. Inner band cracks of this type must not extend into the mounting flange.

(2) Accept one circumferential crack ("L") extending from one partition slot to an adjacent partition slot provided there is only one such crack per section of 4 adjacent partitions.

Note

Inspector must determine when a combination of permissible cracks (types "K", "N" and "L") may endanger a section of the turbine nozzle.

c. Accept cracks ("O") in the weld between a partition and the inner or outer spacer band provided total accumulated length of cracks does not exceed 25 percent of the length of the weld around the partition contour.

d. Accept dents in the inner and outer spacer bands, provided they do not exceed 1/16 inch in displacement.

e. Accept nicks in the inner and outer spacer bands, provided they do not exceed 1/3 the metal thickness and have not started in excess of 3/32 inch in length.

4–144. MISCELLANEOUS CHECKS.

a. Accept no cracks (J, figure 4–67) in weld between the inner band and the mounting flange.

b. Replace the turbine nozzle if the mounting flange is cracked.

c. White powdery deposits found on turbine nozzles used on J47–25 series engines are caused by the calcium and magnesium contained in the water and alcohol mixture. This condition is not detrimental and will not be cause for rejection of turbine nozzle.

d. Inspect the mounting flange for distortion. Replace the turbine nozzle if distorted mounting flange causes assembly difficulty.

e. The saw cut measurement between segments is not critical. It may be noted that the gap is completely closed. This condition is of no concern unless the inner or outer spacer bands give evidence of buckling or have a tendency to overlap.

f. Two or more types of damage may occur to a single partition or unit. Each instance of damage may be within limits, however a combination of the 2 may cause a structural weakness. In other cases, damage to a nozzle may be so extensive that the repair and resultant alignment required may make it impractical to rework. Complete coverage of these types of failures must be associated with experience and the specific nature of the damage.

4–145. REPAIR OF TURBINE NOZZLE ASSEMBLY.

4–146. Repair the nozzle assembly if the damage is located in a repairable area, and provided the allowable repair limits are not exceeded. If facilities are not available for the required repair, the turbine nozzle will be replaced.

Note

Repair weld with the metal arc process, using type 347 columbium stabilized rod (AMS 5681B or D).

a. Do not weld on the nozzle partitions.

b. V-groove cracks in inner and outer spacer bands exceeding the limits of paragraph 4–143b, and fill with weld. Do not weld repair cracks extending into the mounting flange. Dress welds on the inner and outer spacer bands flush to 0.030 inch above the parent metal.

c. V-groove cracks in the weld between a partition and the inner or outer band that exceed the limits of paragraph 4–143c, and fill with weld.

d. V-groove and weld cracks in the weld between the inner band and mounting flange.

e. One partition per segment for a total of 8 partitions may be replaced in a turbine nozzle as outlined in the following instructions:

(1) Grind the weld metal down to the surface of the spacer bands on both ends of the nozzle partitions

to be replaced. Use the side of a small grinding wheel (approximately 2 inches) to carefully remove the blade material below the surface of the spacer band, leaving as much of the punched band contour as possible for locating the replacement partition.

(2) Remove the defective partition by driving it through the spacer bands toward the center of the turbine nozzle. If necessary, burn the partition through its middle with an arc welder and carbon electrode, or use a metal-arc electrode with excessive amperage. Punch the halves of the partition out of the bands.

(3) File out the punched contour in the spacer band to fit the new partition. If the contour of a partition slot is damaged so that the new partition will not fit into position, place a copper insert in the slot and weld. Remove the insert and file or grind to fit replacement.

(4) Assemble the new nozzle partition in place.

(5) In order to keep the spacer bands from distorting during rewelding of the new partition, keep them at their original radial spacing by installing 4 jacking bolts and nuts in the bands, 2 at the entrance side and 2 at the exit side of the blade space. (See figure 4-69.) The length of the bolts should be about 1/16 inch less than the radial height of the passage between the spacer bands, and the nuts should be tightened only finger-tight to prevent forcing the bands apart.

(6) Weld the new partition in place using the welding process and filler rod specified in table VIII.

(7) Remove the 4 jacking bolts and nuts after the welded areas have cooled to room temperature.

f. Re-inspect visually turbine nozzles subjected to repair welding.

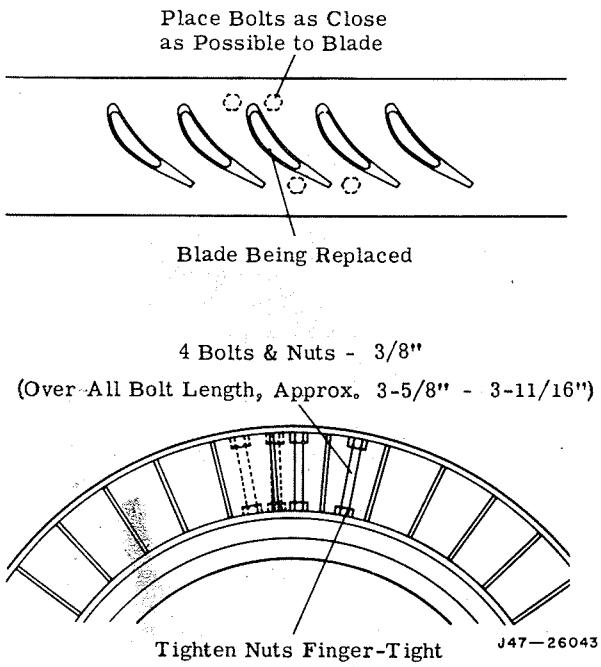

Place Bolts as Close
as Possible to Blade
Blade Being Replaced
4 Bolts & Nuts - 3/8"
(Over All Bolt Length, Approx. 3-5/8" - 3-11/16")
Tighten Nuts Finger-Tight
J47—26043

Figure 4-69. Position of Jacking Bolts for Turbine Nozzle Partition Replacement

g. When replacing a damaged turbine nozzle, selection of a nozzle with an area as near as possible to the area of the nozzle being replaced is not necessary. There are isolated cases where the area size need be increased, decreased or maintained relatively the same to condition the engine properly (bring EGT, SFC, thrust and/or acceleration within limits). The J47-23 engine should have nozzles with a throat area from 114 to 118 square inches. The J47-25, -25A and -27 engines should have nozzles with a throat area from 116 to 120 square inches.

4-147. TURBINE CASING.

4-148. INSPECTION. Visually inspect turbine casing for damage. Cracks are most evident in the areas of the welds. Turbine casings used on the J47-23, -25 and -27 engines may be of stainless steel or low carbon steel type. Inspection procedures given in this paragraph are applicable to both types of casings, except where otherwise noted. Replace the turbine casing if the inspection limits or the repair limits are exceeded.

a. Accept turbine casing which exhibits cracks in the inner flange from the transition liner mounting pin holes extending away from the casing material (figure 4-70). Repair weld cracks from pin holes extending toward the casing material.

b. Repair weld cracks in the welded areas of the stainless steel turbine casing (unpainted casing) if

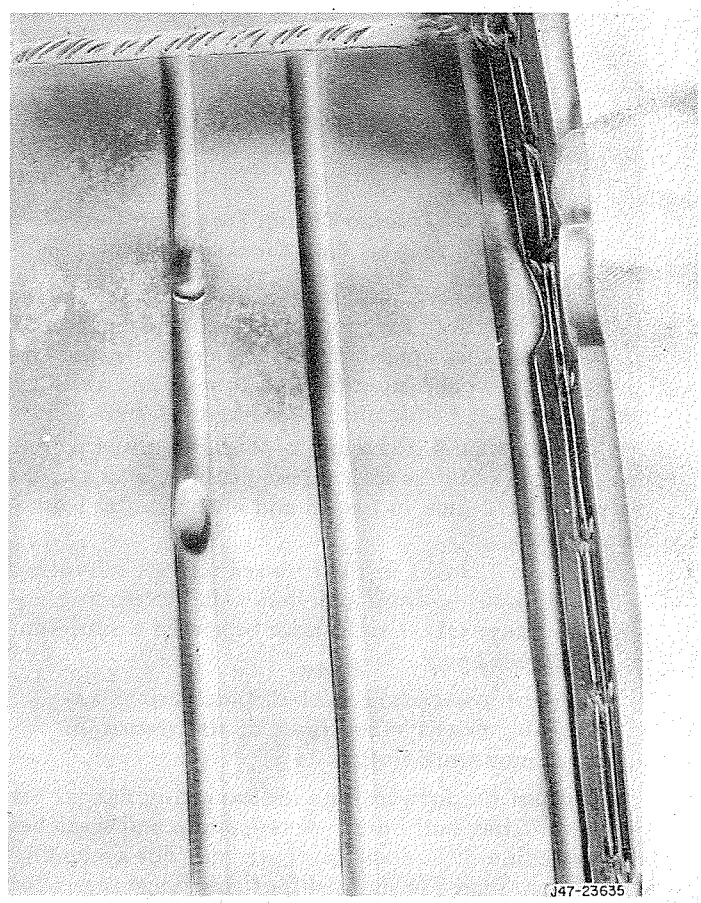


Figure 4-69A. Turbine Casing

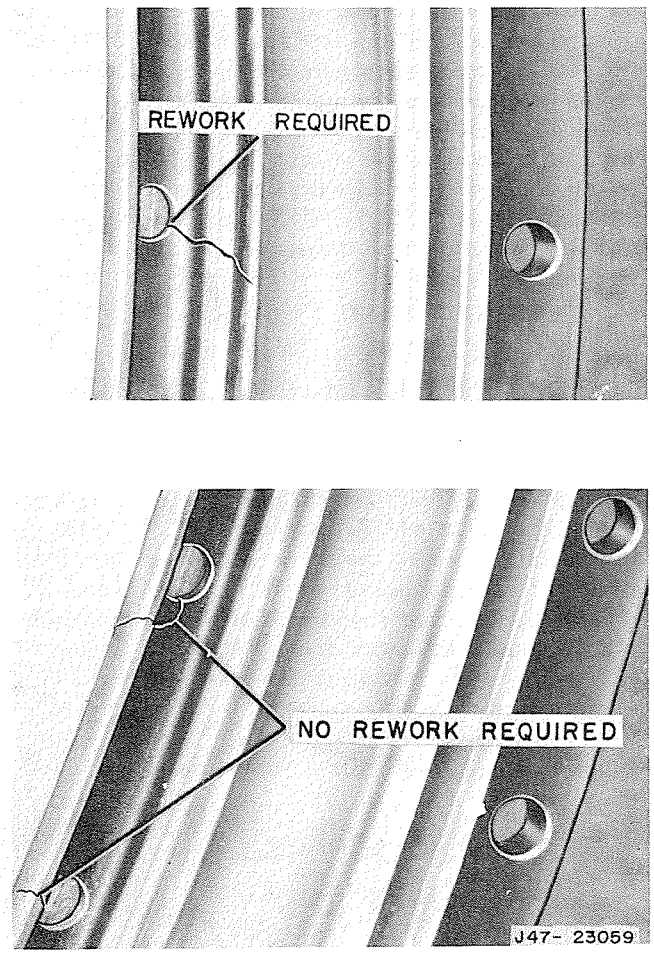


Figure 4–70. Turbine Casing Transition Liner Support Ring Cracks

cracks do not exceed one inch in length or a total accumulated length of four inches. Cracks must be spaced at least six inches apart. Transverse cracks in the circumferential welds (stainless and low carbon casings) may be removed by blending. (See figure 4–69A.)

c. Repair weld a maximum of 2 cracks in the parent metal of the stainless steel turbine casing, if cracks do not exceed 1/2 inch in length and are spaced at least 8 inches apart.

d. Accept 2 cracks in the forward and aft mounting flanges emanating from bolt holes and extending toward the flange OD. Cracks must be spaced a minimum of 90 degrees apart.

Note

Replace low carbon steel turbine casings exhibiting cracks other than in the transition liner mounting ring.

e. Inspect the forward and aft mounting flanges for nicks, scratches, and burrs. Accept nicks and scratches not exceeding 1/32 inch in depth and not extending across more than 3/4 the width of the flange face after removal of high metal.

f. Replace the turbine casing if assembly difficulty is encountered due to out-of-round or out-of-square mounting flanges.

g. Remove corrosion and rust from the surfaces of the low carbon steel casings. Remove high metal from all acceptable nicks and scratches. Corrosion protect by applying a coat of silicon aluminum paint, air drying, stock No. 7300–611800 or equivalent.

h. Inspect the inside and outside surfaces of the casing shell for nicks, scratches, rust and corrosion. Accept corrosion pitting, nicks, and scratches provided shell cross section has not been reduced more than 0.025 inch. Repair weld damage to stainless steel turbine casings exceeding this limit provided total weld area does not exceed 2 square inches.

i. Inspect the turbine casing for bulges. Accept turbine casings with bulges if the following limits are not exceeded.

(1) The transition liner mounting flange must not be distorted.

(2) Mounting flanges must not be out-of-round more than 0.100 inch and flanges must be parallel within 0.015 inch.

(3) There must not be any bulge in flange that would interfere with assembly.

(4) Maximum bulge dimensions are 3/8 inch in height, 8 inches wide (circumferential) and 6 inches long (axial). Three bulges per casing are acceptable, spaced a minimum of 20 inches center to center.

(5) Inspect turbine casing drain and T-connector drain mounting flange surfaces for distortion, using a surface plate and feeler gage. Accept flange distortion up to 0.005 inch. Resurface flanges if this limit is exceeded.

j. Repair excessively worn sections of the pin hole ring inner surface as prescribed in paragraph 4–149d.

4–149. REPAIR.

a. Repair weld stainless steel turbine casing, and the transition liner mounting ring on low carbon steel turbine casings, using the inert arc process. Use 347 S.S. wire for filler material.

b. Repair weld cracks in the inner flange, from the transition liner mounting pin holes extending toward the casing material, and dress to the original contour. Ream the pin holes to size if necessary.

c. V-groove cracks in stainless steel turbine casings and weld. Cracks must be within the repair limits specified in paragraphs 4–148b and c. Transverse cracks in the circumferential welds (stainless and low carbon casings) may be removed by blending (figure 4–69A). Do not blend below the surface of the parent metal. Inspect the area after blending, using the red dye-penetrant method.

d. Build up worn sections of the transition liner pin hole ring inner surface with weld and bench to the original contour.

e. Fill nicks and scratches in stainless steel casings within the repair limits of paragraph 4–148h. Dress welds to original contour.

f. Drill and tap damaged threaded holes to receive

a stainless steel bushing screw. Securely lock the bushing screw with a pin.

g. Remove high metal from all acceptable nicks and scratches.

h. Re-inspect visually turbine casing subjected to repair welding.

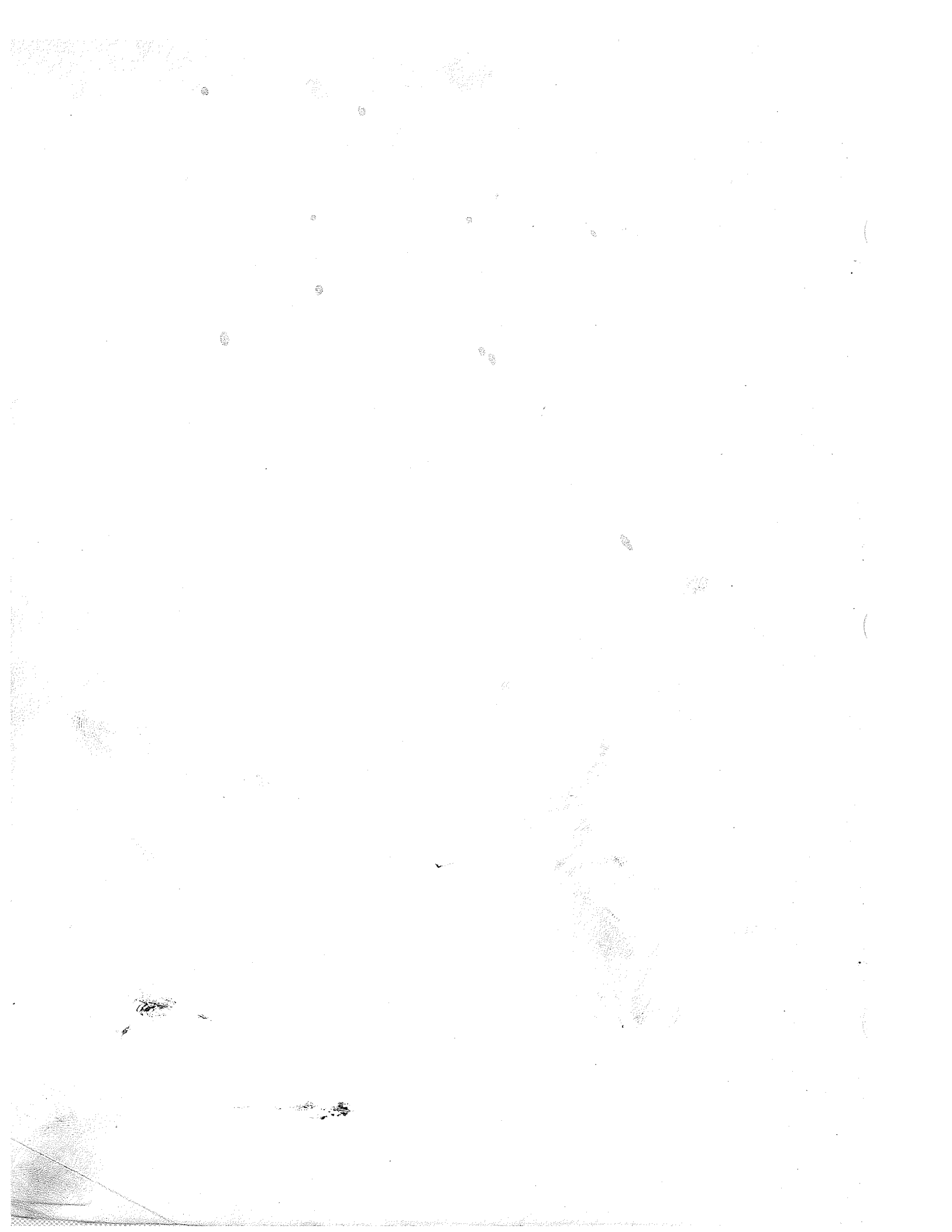
4-150. TURBINE SHROUD RING.

4-151. INSPECTION. Visually inspect the shroud ring for damage such as cracks, nicks, dents, and distortion. Replace the shroud ring if the acceptable limits or the repair limits are exceeded.

a. Inspect shroud rings that have been reworked with a weld across the width of the ring as follows:

(1) Inspect the split line weld for cracks using the spot-fluorescent-penetrant method. Repair weld all cracks.

(2) Accept welds containing oxide inclusions, provided there are not more than four inclusions per weld. Inclusions must not exceed 0.020 inch in



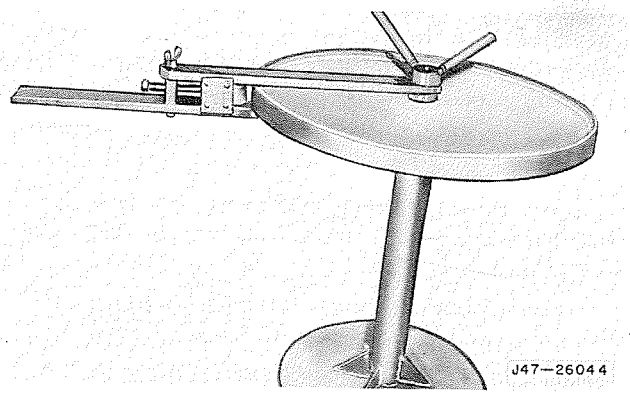


Figure 4-71. Shroud Ring Stretching Fixture

diameter and must be spaced at least 1/4 inch apart. Repair weld conditions exceeding these specifications.

b. Inspect the ring parent metal for cracks. Replace the ring if cracks are noted.

c. Inspect the ring for nicks and dents. Accept nicks and dents to a depth of 1/32 inch and a maximum dimension of 1/2 inch. Repair weld nicks and dents exceeding this limit, provided metal has not been upset on the outer circumference of the ring.

d. Shroud rings which have been rejected due to insufficient clearance between turbine bucket tips and shroud ring ID, may be reworked as specified in paragraph 4-152e.

4-152. REPAIR OF TURBINE SHROUD RING.

a. Repair weld the shroud ring with inert arc welding equipment, using type 347 filler rod.

b. V-groove cracks exceeding the limits of paragraph 4-151a, and fill with weld. Dress to the original contour.

c. Remove high metal from all acceptable nicks using a fine file, Arkansas stone, or equivalent.

d. Fill nicks and dents exceeding the maximum depth limit with weld provided metal has not been upset on the outer circumference of the ring. Dress weld to the original contour.

e. Reform shroud rings which have shrunk in service by heating the ring to approximately 260°C (500°F) and placing the ring on a fixture similar to the one in figure 4-71. The diameter of the forming block should duplicate the nominal B/P dimension (34.508 inches). Use the rolling attachment only if the ring is difficult to remove from the forming block, after it has cooled to room temperature.

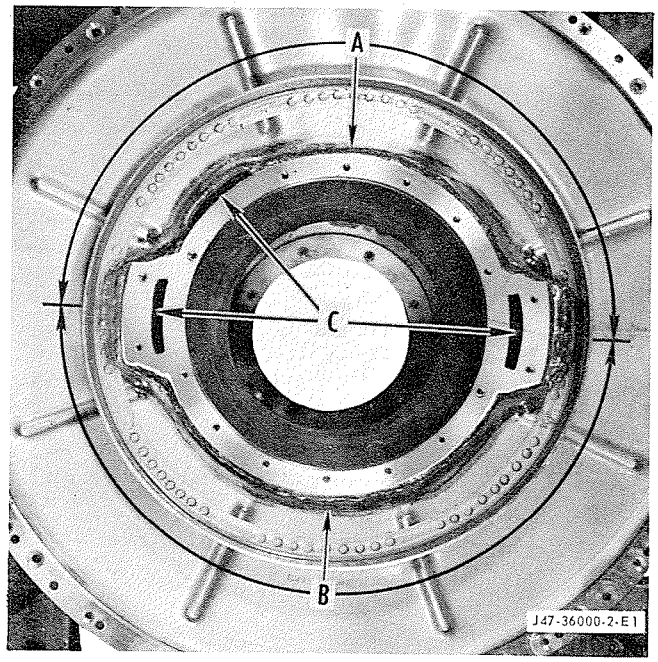


Figure 4-72. Inspection Limits for Turbine Frame

4-153. TURBINE FRAME. (See figure 4-72.)

4-154. INSPECTION AND REPAIR.

a. Inspect the turbine frame for weld cracks near the No. 4 bearing housing support ring. No welding is permitted near the housing support ring due to the possibility of excessive distortion and misalignment of the No. 4 bearing housing. Replace any turbine frame that requires repair welding near the No. 4 bearing housing support ring, or that has cracks which exceed the allowable crack limits.

NOTE

Replace the turbine frame if there is evidence of excessive oil consumption, oil leakage, or oil smoke coming from the turbine section area, even though cracks are within limits given in paragraph 4-154c.

b. Allow an eight inch crack or several small cracks totaling eight inches or less in the weld areas "A" and "B" provided the total length of all cracks does not exceed 16 inches. (See figure 4-72.)

c. Allow cracks inside the seal vent pads or cooling air tube area "C" provided the turbine frame has not

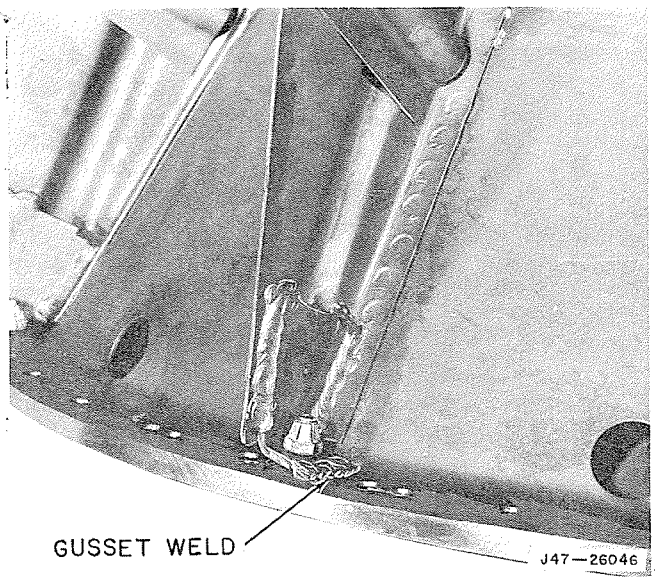


Figure 4-73. Cracks in Gusset Support Weld

leaked an excessive amount of oil in service. (See figure 4-72.)

d. Inspect the circumferential weld at the forward end of the bearing housing support ring. The frame is serviceable if cracks in the weld are less than 1½ inches long and if no crack is closer than three inches to another.

e. Allow any number of cracks in the weld between the web ear support and nozzle diaphragm mounting flange (see figure 4-73) provided the screw attachment holding the support to the flange is secure. V-groove and weld all cracks in web ear support and in the weld attaching the support to the aft frame gusset. After weld repair, inspect using the red dye-penetrant method.

f. Inspect the tubing and fittings for cracks. Replace any cracked parts.

g. Inspect threaded holes, and re-tap any with damaged threads. If a repair cannot be effected, replace the turbine frame.

h. Inspect mounting flanges for nicks and burrs. Remove high spots with an Arkansas stone, or equivalent.

i. Inspect the sheet metal gussets and cones for cracks or breaks. Weld repair may be used, provided the No. 4 bearing housing area is not affected.

j. Inspect the transition liner mounting brackets (J47-25A engines) for cracks or loose rivets. Replace any cracked brackets or loose rivets.

k. Remove cracks in weld around lifting boss that do not exceed 0.025 inch in depth, by local blending. Repair cracks from 0.025 inch to 0.100 inch in depth by V-grooving to completely remove cracks. Fill weld and blend to original contour. Replace the turbine frame if crack exceeds 0.100 inch in depth or if welding results in turbine casing mounting flange warping beyond limits (0.060 inch flatness).

l. Modify turbine frames, P/N 8481861, P/N 7019-E61 and P/N 7021E40 as follows:

(1) Drill one 0.375 inch diameter hole on each side of the existing drain slot on a reference angle of

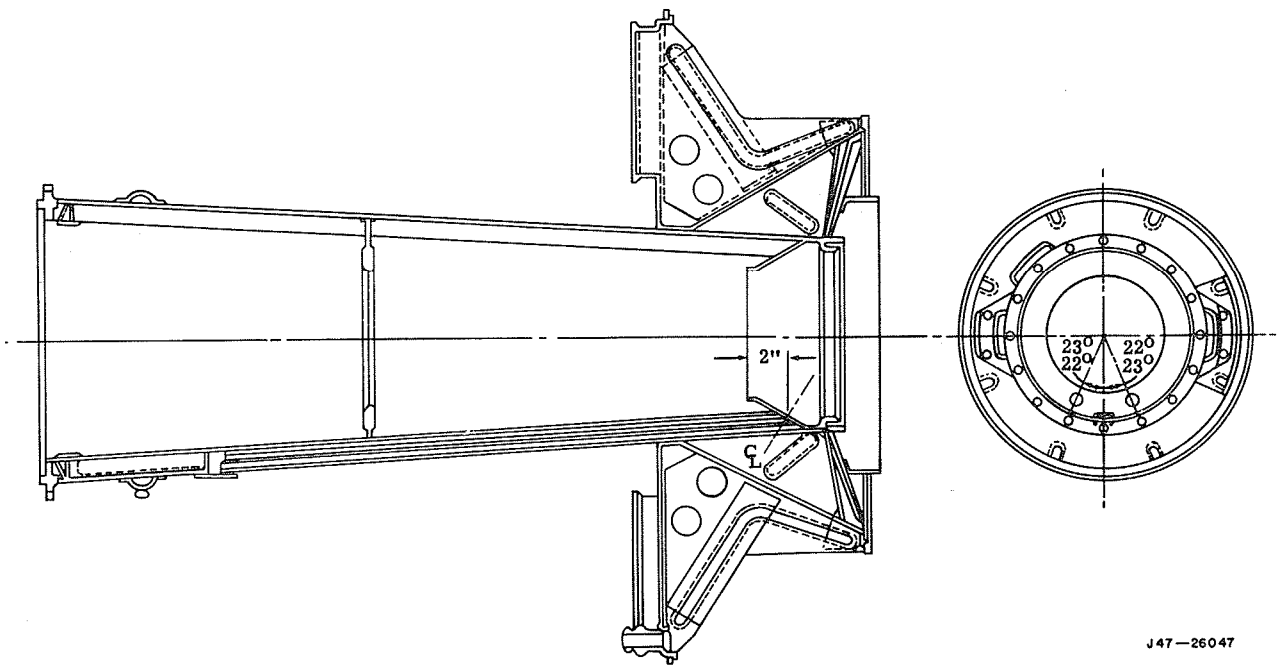


Figure 4-74. Modification of Turbine Frame Aft Shield Support

22 to 23 degrees from the vertical and located 2 inches axially from the forward edge of oil baffle. (See figure 4-74.)

CAUTION

Extreme care must be exercised to prevent metal shavings from falling into the monocoque and drilling too far into adjacent monocoques. Remove all metal particles from within the frame after the drilling operation.

(2) To identify the turbine frames with the reworked aft shield support, obliterate the old part number, and metal stamp, or electrically etch, the new part numbers on the turbine frame flange. The following remarking will identify the change:

Old Part No.	Rework Part No.
8481861	7025R93
7019E71	7025R92
7021E40	7025R94

m. In order to permit installation of the more durable annular transition liners, modify turbine frames P/N 7025R92, P/N 7025R93, and P/N 7025R94 as follows. See figure 4-75.

(1) Place the turbine frame in a vertical position, resting on the forward mounting flange.

(2) Modify the turbine frame by locating and installing brackets as shown in figure 4-75.

(3) Location of the support brackets may be accomplished by using slave annular transition liners. Insert all transition liners in the aft flange ports.

(4) Fabricate a ring fixture from AMS5062 bar stock (or equivalent). Butt weld and machine to dimensions shown in figure 4-75.

(5) Install the ring fixture as indicated to position the transition liners radially.

(6) Locate transition liner brackets on turbine frame gussets radially flush with transition liners, and axially to dimension 4.60-4.66.

(7) Drill 4 rivet holes using No. 30 drill (0.1285), as shown in figure 4-75.

(8) Rivet brackets in place using washer AN960C4 and rivet AN435M4-6.

(9) Position the transition liners axially so that the bolt hole is approximately in the center of each bracket. Using the transition liner holes as templates, drill the 0.281 (9/32) hole in each bracket.

(10) If slave transition liners are not used, locate the brackets radially 12.210-12.230 from the frame centerline, and 4.60-4.66 from the rear flange face. Locate the 0.281 hole in the approximate center of the bracket. (See step 9.)

(11) After installation of the brackets, line out the old frame part number and remark the modified frames P/N 7025R92, P/N 7025R93, P/N 7025R94 as P/N 7026R37.

4-155. INSPECTION AFTER REPAIR.

a. Inspect the No. 3 and No. 4 bearing housings. The inner diameter of the bearing housings should be within limits in Section VIII, Reference Nos. 62 and 56.

b. If the turbine frame barrel, cooling air tubes, or fittings are repaired, pressure-test the turbine frame as follows:

(1) Place caps or blank pads on all the openings.

Note

One of the caps or blank pads must be suitable for the introduction of compressed air. All caps or blank pads must be gasketed to provide an adequate air seal.

(2) Pressurize barrel to 20 psig. With air shut off, barrel must hold 20 psig for 2 minutes.

(3) If a pressure drop is noted, apply soap and water mixture to the gaskets, caps, welds, and fittings to locate leak.

(4) Repair weld leakage areas provided they are within acceptable repair areas.

4-156. LUBE OIL JETS.

4-157. INSPECTION AND REPAIR.

a. Inspect the lube oil jets for cracks, nicks, scratches, dents, burrs, and defective fittings as follows:

(1) Replace cracked oil jets.

(2) Accept nicks and scratches not exceeding 1/64 inch after removal of high metal.

(3) Accept dents in the tube not exceeding 1/5 of the tube diameter.

(4) Replace any defective fittings.

b. Inspection of jet nozzle openings:

(1) Inspect jet nozzle openings with a locally manufactured go no-go gage. (See Note below.) If jet nozzle openings exceed the maximum limits replace the lube oil jets. If jet nozzle openings are below the minimum limits, re-bore to proper size.

Oil Jet Bearing No.	Nozzle Opening Min.	Nozzle Opening Max.
2	0.110	0.115
3	0.074	0.078
4	0.078	0.082

Note

A suitable gage for go no-go checking on jet nozzle openings would be a bore of the proper size. For a nozzle opening of 0.110-0.115 use bore size No. 35 (go) and size No. 32 (no-go); for a nozzle opening of 0.074-0.078 use bore size No. 49 (go) and size No. 47 (no-go); for a nozzle opening of 0.078-0.082 use bore size No. 48 (go) and size No. 44 (no-go).

4-158. TURBINE WHEEL.

4-159. DELETED.

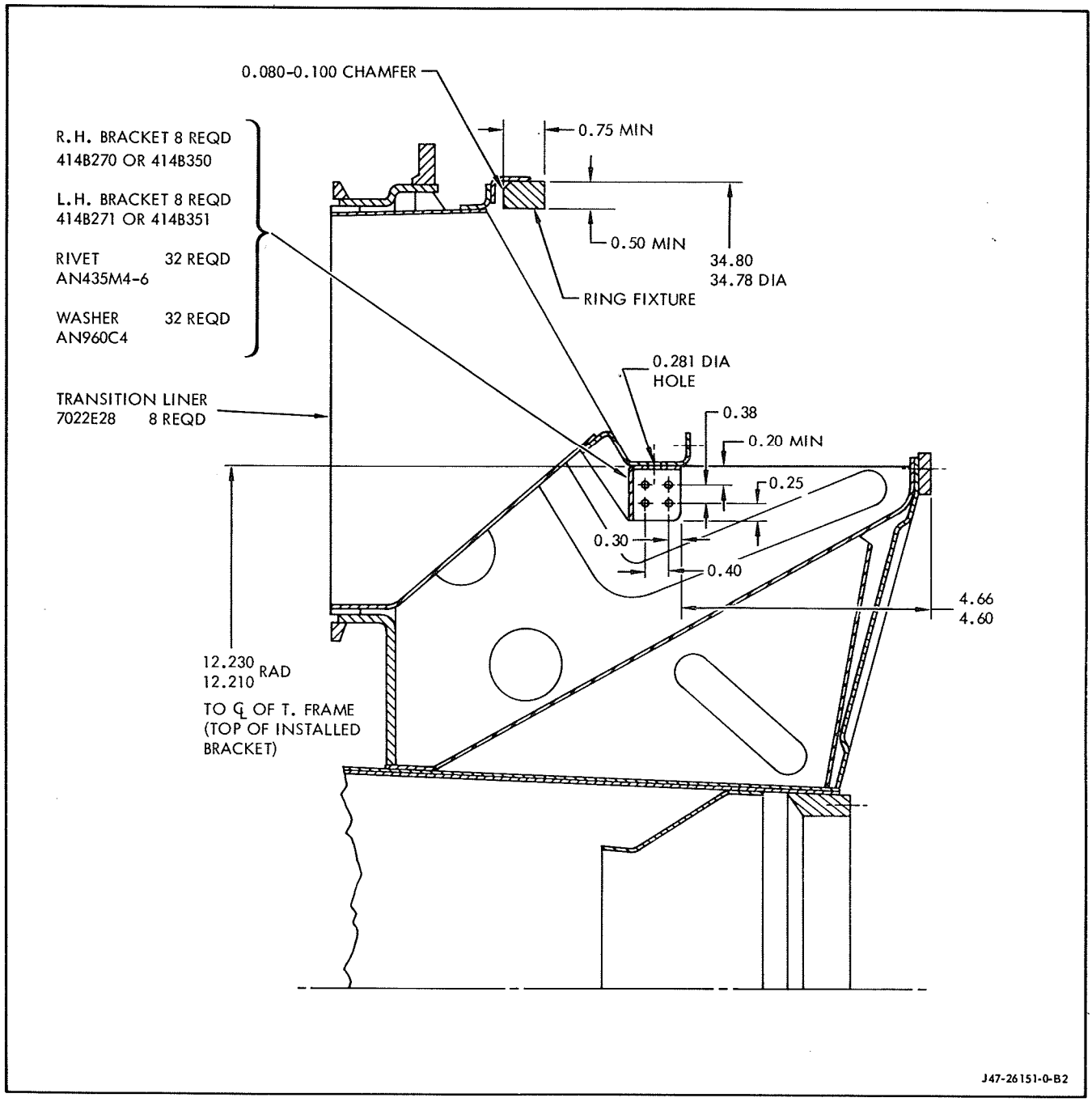


Figure 4-75. Installation of Transition Liner Brackets on Turbine Frame

4–160. INSPECTION AND REPAIR.

a. Check the AFTO Form 44 and all other available data on the turbine wheel. Reject the wheel to an overhaul facility for any of the following:

(1) Engine overspeed above 104 percent to 108 percent.

(2) Overtemperature conditions as defined in figure 7–16 and Table XXXIII.

(3) Deleted.

(4) If any buckets are removed, visually check the wheel rim for cracks originating at the pin holes (pin-type wheels). Reject the wheel to an overhaul facility if a crack is detected.

b. Inspect the turbine wheel shaft for pickups, burrs, nicks, or deep scratches on the splined section and near bearing locations. Remove slight surface defects

with an Arkansas stone. Wipe clean and apply a thin film of Grade 1010 oil to shaft.

c. Turbine wheel shaft threads that have been damaged will be acceptable after rework providing no more than 3 complete threads require removal.

(1) Inspect the No. 3 bearing locknut threads for damage. Remove high metal and blend to a smooth contour. To remove staking damage in the set screw holes, chase the threads with a 1/4-20 tapered tap. Use care to prevent cross threading the screw holes.

d. Inspect the rear face of the turbine wheel for indications of rubbing by exhaust cone deflectors. If scoring is found, return the wheel to overhaul.

e. With the buckets in place, inspect the turbine wheel rim for cracks originating at the pin holes in the wheel rim. Replace the turbine wheel if any cracks are found in the front or rear edge of the wheel rim.

f. Deleted.

g. Deleted.

h. Check the turbine wheel and turbine shaft dimensions at the air and oil seal shelf, at the air and oil seal spacer, and at the No. 3 and No. 4 bearing journals. Replace the turbine wheel if diameters exceed serviceable limits (reference No. 45, 52, 57, and 66). Inspect the turbine wheel for wheel growth as follows:

(1) Measure the diameter of the wheel midway between the faces on the outer rim at 8 equally spaced points, using a 36-inch vernier caliper (stainless steel, nonmagnetic type). The maximum allowable diameter is 26.738 inches with correct dimensions as follows:

(a) Subtract 0.001 inch from the vernier caliper reading with the temperature below 10°C (50°F).

(b) No correction is necessary for temperatures ranging from 10°C to 29.5°C (50°F to 85°F).

(c) Add 0.001 inch to the vernier caliper reading when temperature is above 29.5°C (85°F).

(2) An alternate method is to measure the diameter of the wheel midway between the faces on the outer rim at 8 equally spaced points, using a 27-inch outside micrometer. The maximum allowable diameter is 26.738 inches.

NOTE

Subject the wheel and the gage to the same room temperature over a period of 4 hours or longer, prior to taking measurement.

(3) Record the turbine wheel diameter and location of the high spot (largest diameter) on the AFTO Form 44.

i. Inspect the wheel hub area for pits as follows:

(1) Accept pits on the forward face of the wheel between the shaft and weld diameter, if they do not exceed 0.007 inch deep.

(2) Accept pits on the aft side of the wheel inside the weld diameter, if they do not exceed 0.007 inch deep.

(3) Rework isolated pits in excess of the above limits by local blending to a maximum depth of 0.040 inch on either the forward or aft face. The accumulative total depth for both faces is not to exceed 0.040 inch.

(4) Accept scoring on the rubbing seal shelf not exceeding 0.025 inch in depth after removal of high metal and/or aluminum build-up.

(5) Accept pits, nicks, dent and gouges on the rubbing seal shelf not exceeding 0.050 inch in depth after removal of high metal.

j. Replace the wheel if any pits or indications exceed these limits.

k. Inspect end of turbine shaft for wear where it mates against compressor nut, P/N 9451417. Wear in excess of 0.010 inch depth is cause for rejection to depot. Check depth of wear with a micrometer depth gage resting across the unworn surface of the shaft end.

NOTE

Turbine wheel shafts which have undergone previous depot repair for worn shaft ends by incorporating shim, P/N 8481588, on the end of the shaft, may be repaired locally if end wear is in excess of 0.010 inch. Replace worn shim and attach new shim with three flathead screws, P/N AN505C416-10. Torque screws to 25-35 lb-in. The screw heads must be flush with or below the shim surface after torquing. This may require dressing down the heads. Stake screw head in one place and if necessary remove the raised surface caused by staking.

Figure 4-76. Deleted.

Figure 4-77. Deleted.

4–161. TURBINE BUCKETS.

4–162. INSPECTION. Many conditions necessitate replacement of individual turbine buckets; an accumulation of such defects may require replacement of the turbine wheel. (Refer to paragraph 4–162g.) Whenever turbine bucket damage exceeds detail repair or rework limits, the buckets must be removed and replaced. (Refer to paragraph 3–66 for bucket removal instructions.)

a. Replace all buckets where circumferential movement at the bucket tip (tip shake) exceeds 0.125 inch. Do not discard replaced buckets as they may be acceptable in another dovetail position.

Note

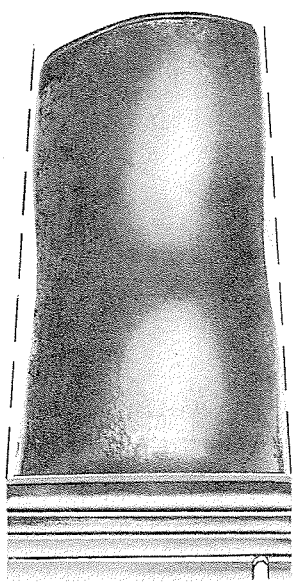
On turbine rotor using locking strips, tip shake must be between 0.016 and 0.125 inch.

b. Replace all cracked buckets and all buckets having compound or "S" curvature in the leading or trailing edges. (See figure 4–78.)

Note

If 10 or more buckets require replacement because of cracks or compound S-curvature, it may be assumed the wheel has been subjected to adverse operating conditions and the wheel must be rejected to an overhaul facility.

c. Replace all buckets damaged by nicks and dents beyond the repairable limits shown in figure 4–79.



J47—26050

Figure 4–78. Compound or "S" Curvature

d. Replace all buckets which require more than 4 repairs.

e. Replace all buckets where repairs on opposite sides coincide so as to reduce the cross section of the bucket more than the allowable depth of one repair.

f. Replace any buckets that have portions missing.

g. If 72 or more buckets require replacement, reject the wheel to an overhaul facility.

h. Replace any bucket which has pits larger than 1/64 inch in diameter.

i. Inspect all buckets for total axial movement of the dovetail base. Re-pin any bucket that can be moved forward and aft by hand more than 0.010 inch.

4–163. REPAIR. (See figure 4–79.)

a. Minor damage to turbine buckets may be repaired provided the damage is located in a repairable area and the benching-out that is necessary to remove the damage does not exceed the allowable repair limits.

Note

Do not attempt to straighten dents as this may aggravate the damage.

(1) In area "A", bench and blend out damages, if rework will not exceed a depth of 0.010 inch and a diameter of 1/8 inch.

(2) In area "B", bench and blend out damages, if rework will not exceed a depth of 1/16 inch in the upper 3/4 of bucket and 1/32 inch in the lower 1/4 of bucket.

(3) In area "C", bench and blend out damages, if rework will not exceed a depth of 0.020 inch and a diameter of 1/4 inch.

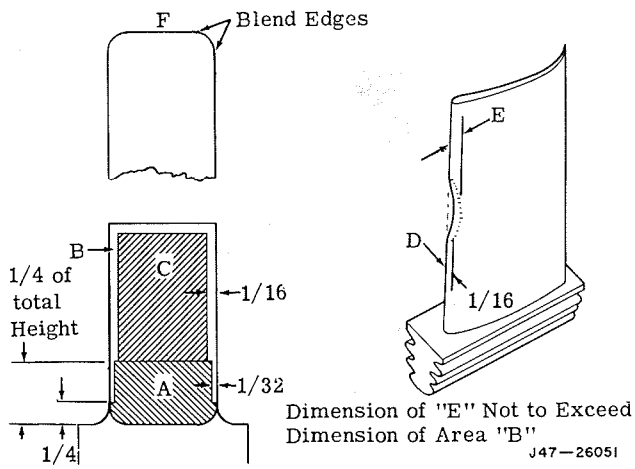


Figure 4–79. Areas of Turbine Bucket Rework

(4) Bench and blend out dents on the leading or trailing edges, area "E," if the dents do not exceed the limits of area "B."

(5) Dimension "D" indicates the maximum allowable displacement of the edge of the bucket. Displacement must not exceed 1/32 inch in the lower 1/4 or 1/16 inch in the upper 3/4 of the bucket length.

(6) Repairs on opposite sides of a turbine bucket, which coincide so as to reduce the cross section by more than the maximum depth of one repair, are not allowed.

(7) In area "F," accept curling on tip corners up to 1/4 inch from the tip end. Remove curling which exceeds 1/4 inch by blending to form a 3/8 inch radius (approx) at the tip corner.

(8) The maximum number of repairs on any one turbine bucket is 4.

b. Polish out any minor irregularities along the leading or trailing edges.

Note

A bucket with a profusion of irregularities may have no more than 0.010 inch of material removed from the entire leading face. Do not remove material within 1/4 inch of the blade root.

c. Accept circumferential scores across ends of bucket dovetail up to 0.020 inch in depth.

4–164. PART NUMBER MARKING (IDENTIFICATION) OF TURBINE WHEELS.

a. Prior to installation and during periodic inspection or field maintenance on the engine, inspect and make sure that the turbine wheel (both pin and locking-strip-type wheels) is correctly identified as P/N 8992575, 8992575-3, 7032R96G1, or 7032R96G4, whichever is applicable.

Note

Turbine wheels are no longer restricted between J47-17B/-33 engines (D series) and J47-23, -25 -25A, and -27 engines (E series). Therefore, identification by the letter "D" and "E" prefix to wheel part number is no longer required. Also, turbine buckets P/N 122D350, 124D653, 124D960, 124D962, *303D349P1, *303D357P1 and 8992645 are completely interchangeable and any combination can be used without affecting or changing the turbine wheel part number.

*Turbine buckets P/N 303D349P1 and 303D357P1 are 8992645 and 124D653 buckets that have been reworked to control or decrease trailing edge dimensions.

b. Delete the letter "D" and "E" prefix to the part number on both the turbine wheel and AFTO form 44.

c. Use a metal punch and identify the turbine wheel (refer to figure 4–80 for proper location) to the correct part number as follows:

(1) Turbine wheels with one asterisk (*) as listed below will be converted or identified to part number 8992575, FSC 0259-2840-312-9294.

(2) Turbine wheels with two asterisks (**) as

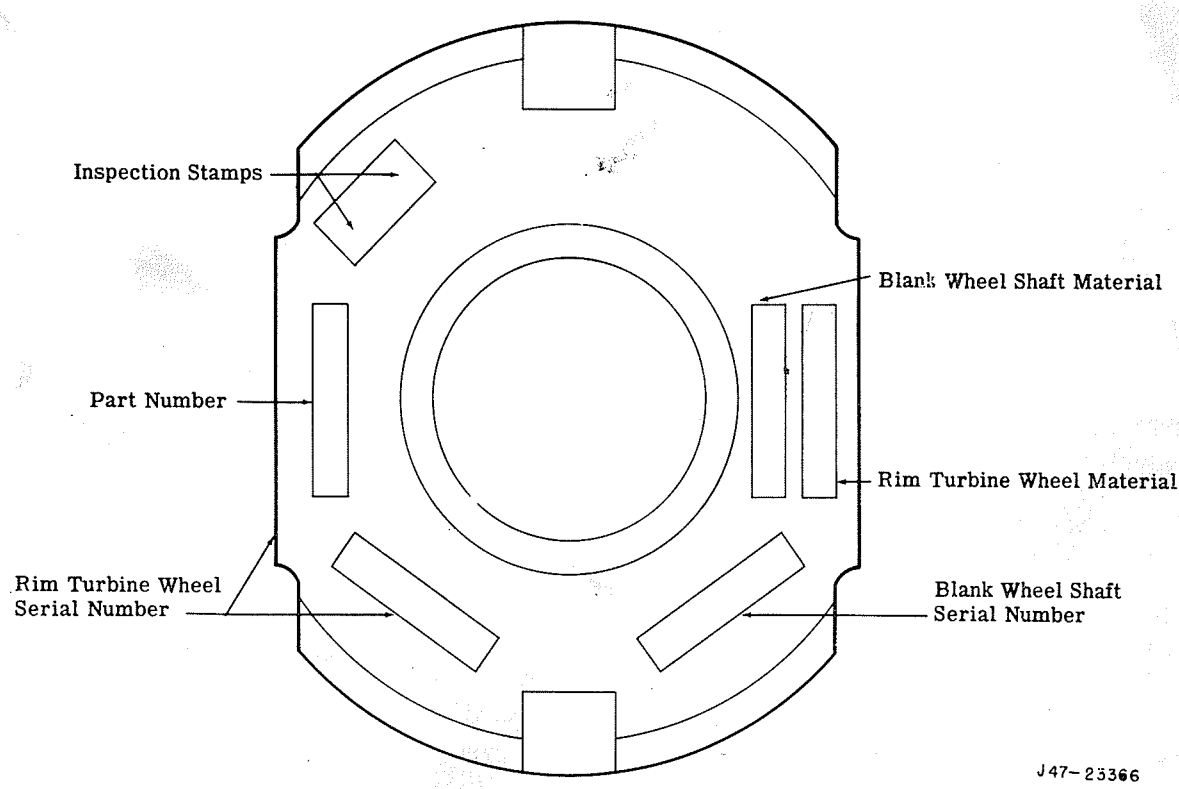


Figure 4–80. Identifications of Turbine Wheel

listed below will be converted or identified to part number 8992575-3, FSC 0259-2840-320-2741.

(3) Turbine wheels with three asterisks (***) as listed below will be converted or identified to part number 7032R96G1, FSC 0259-2840-320-2724.

(4) Turbine wheels with four asterisks (****) as listed below will be converted or identified to part number 7032R96G4, FSC 0259-2840-312-9281.

WHEEL PART NUMBER	FSC NUMBER
*8992575-1	0259-2840-320-2740
*8992575-2	0259-2840-396-5900
*8992575-6	0259-2840-345-6915
*D8992575	0259-2840-348-3489
*D8992575-1	0259-2840-586-5843
*D8992575-2	0259-2840-348-3490
*D8992575-6	None Assigned
*E8992575	0259-2840-614-7024
*E8992575-1	None Assigned
*E8992575-2	0259-2840-632-3023
*E8992575-6	None Assigned
**8992575-4	0259-2840-326-8012
**8992575-5	0259-2840-320-2742
**8992575-7	None Assigned
**D8992575-5	0259-2840-632-3024
**E8992575-3	0259-2840-614-7025
**E8992575-4	None Assigned
**E8992575-5	0259-2840-632-3025
**E8992575-7	None Assigned
***508E574-1	0259-2840-219-3072
***508E574-2	0259-2840-034-8999
***508E574-3	0259-2840-030-4014
***508E574-7	None Assigned
***7032R96G2	0259-2840-312-9280
***7032R96G3	0259-2840-320-2725
***7032R96G7	0259-2840-319-2723
***D7032R96G1	0259-2840-348-3488
***D7032R96G2	0259-2840-568-1494
***D7032R96G3	0259-2840-625-2122
***D7032R96G7	None Assigned
***E7032R96G1	0259-2840-614-7022
***E7032R96G2	None Assigned
***E7032R96G3	0259-2840-632-3021
***E7032R96G7	None Assigned
****508E574-4	0259-2840-219-3073
****508E574-5	0259-2840-698-9058
****508E574-6	0259-2840-213-2274
****508E574-8	None Assigned
****7032R96G5	0259-2840-320-2726
****7032R96G6	0259-2840-312-9282
****7032R96G8	None Assigned
****E7032R96G4	0259-2840-614-7023
****E7032R96G5	None Assigned
****E7032R96G6	0259-2840-632-3022
****E7032R96G8	None Assigned

d. On turbine wheels that have not been previously stamped with bucket location numbers, stamp the 4 numbers on the after face of the turbine wheel rim as shown in figure 4-80A. The numbers should be metal-stamped 3/32 inch high, 0.010 inch maximum depth, and located no closer than 1/8 inch to the serrations. No definite orientation is required for the No. 1 bucket location. The No. 5 bucket must be in the fifth slot clockwise from the No. 1 bucket.

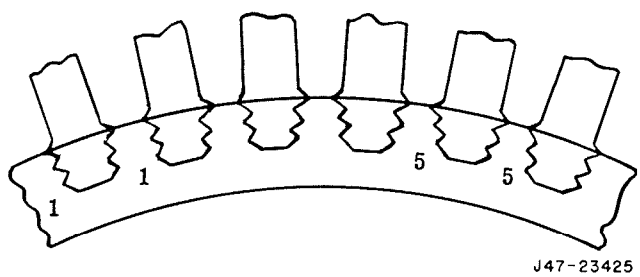


Figure 4-80A. Turbine Wheel Bucket Location Numbers

TABLE XVIII. TURBINE WHEEL IDENTIFICATION AND APPLICATION

Wheel Part No.	Hub Part No.	FSC No.	Engine Application
8992575	8992576	0259-2840-312-9294	J47—17B,—23,—25,—25A,—27, and —33 engines
8992575-3	7024R40	0259-2840-320-2741	J47—17B,—23,—25,—25A,—27, and —33 engines
7032R96G1	7026R40	0259-2840-320-2724	J47—17B,—23,—25,—25A,—27, and —33 engines
7032R96G4	7026R43	0259-2840-312-9281	J47—17B,—23,—25,—25A,—27, and —33 engines

TABLE XIX. DELETED

4-165. REPLACEMENT METHODS. The moment-weighted turbine buckets have numbers from N40 (minus forty) through "60" stamped on the rear face of the base. Buckets which have the same number stamped on them have the same weight within 1/2 gram and have this weight distributed in an identical manner about a reference point located a specific distance from the center of the rotor.

Note

Check all replacement buckets, upon selection, for bucket tip shake prior to pinning or bending locking strip tab. Refer to paragraph 4-162, step "a" and the note following for tip shake limits. Use another bucket if replacement bucket is not within limits.

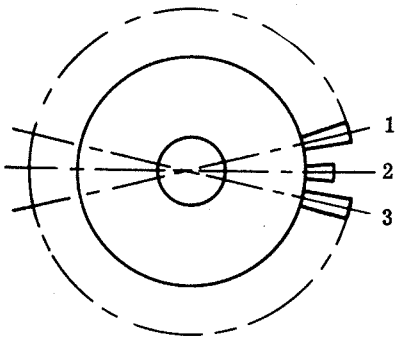
a. When the removed bucket or buckets are identified by moment weight numbers, replace each bucket with one of the same moment weight if available. Replace the same number of buckets 180 degrees from those requiring replacement to retain a more positive turbine wheel balance. With this procedure there is no limit to the number of buckets that may be replaced in any one turbine wheel except as noted in paragraphs 4-162b and g.

b. When the removed bucket is identified with a moment weight number, and a replacement bucket of the same moment weight is not available, use procedure described in steps "c" and "d" below. (See figure 4-81.) No more than 5 damaged buckets may be replaced in this manner.

c. Remove the damaged bucket and one adjacent bucket on each side. Total the moment weight numbers, and select 3 replacement buckets having the same weight number total. Install the 3 replacement buckets in the dovetail slots retaining the respective weights in the same relative location in the wheel as those removed (the heaviest replacement bucket replacing the heaviest bucket in the group of 3 removed). If the two adjacent buckets that were removed are still serviceable, return them to stock for re-use.

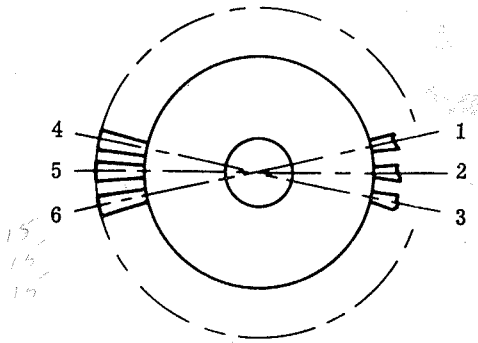
d. Occasionally it may be difficult to select replacement buckets whose moment weight number total exactly equals the moment weight number total of the removed buckets. In this event, compensate for rotor unbalance by removing the 3 buckets located diametrically (180 degrees) opposite the unbalanced group and replace them with buckets possessing a more favorable moment weight differential, thereby tending to restore the rotor balance. (See figure 4-81, Example 2.)

e. Negative moment weight buckets are identified by the letter "N" preceding the moment weight mark stamped on the base of the bucket. When a negative moment weight bucket must be replaced and that exact weight is not in stock, remove the adjacent bucket on each side of the negative moment weight bucket, and algebraically total the 3 bucket weights.



EXAMPLE 1

Bucket No.	Moment Balance No. Before Repair	After Repair
1	40 Adjacent	50
2	*35	30
3	10 Adjacent	5
Total	85 =	85



EXAMPLE 2

Bucket No.	Moment Balance No. Before Repair	After Repair
1	40 Heavy	50
2	*35	30
3	*20 Light	25
Group Total	I 95	105
4	10 Light	10
5	*20	15
6	*35 Heavy	50
Group Total	II 65	75
Difference =	30	Difference = 30

In examples 1 & 2, it is assumed that certain buckets, marked (*), are not available (in LH column) and are replaced by the available spares indicated in the RH column.

(DIFFERENCE = GROUP I MINUS GROUP II)

J47–26052

Figure 4–81. Turbine Bucket Selection Example

For example: if the buckets are stamped "12" "N2" and "10", the algebraic sum would be "20". Replace these buckets with 3 others whose algebraic total is 20. For example: buckets stamped "10" "1" and "9" would be adequate for replacement. Retain the respective weights in the same relative position as those removed.

f. If the turbine wheel is composed of 100 percent negative moment weight buckets, replacement buckets must also be negative moment weight buckets.

4–166. INSTALLATION.

a. Install turbine buckets using roll pins as follows:

(1) Check the dovetail for any burrs or high spots which would give a false indication of fit. Remove any such defects with a fine abrasive paper.

(2) Install the bucket into the wheel serrations and check for tip-shake.

(3) Align the pin holes. A piece of drill rod about 0.100 inch in diameter will aid in aligning the holes.

(4) Install the bucket, using ESNA roll pin, P/N 79–R5000–125–0500. This pin is supplied in one size and is adaptable to any bucket and diameter.

(5) Use a sheet metal guard to protect the turbine wheel face and install the pin with a light hammer and the roll pin driver until it is fully seated and the end is crushed in the bucket slot. Be sure the pin is fully seated before peening.

CAUTION

Care must be taken to prevent driving the entire pin into the bucket slot. This will cause cocking of the pin and misalignment of the bucket.

(6) Check bucket tip shake after pinning. Maximum allowable tip shake is 0.125 inch. Check that axial movement does not exceed 0.010 inch. The bucket dovetail base may project a maximum of 0.015 inch from face of wheel rim. Replace the bucket if these limits are exceeded.

b. Install turbine buckets using locking strips as follows: (Wheel removed from engine.)

Note

Locking strips, P/N's 414B680P1, P2 and 326C850P1 are interchangeable only as complete sets.

(1) Assemble the locking strip to the bucket with both formed tabs against the forward end of the bucket dovetail. (See figure 4–82.)

(2) Install the bucket, with locking strip assembled, by sliding into the dovetail slot of the wheel from the forward side.

(3) Before bending the tab, check the bucket for tip shake. Tip shake should be between 0.016 and 0.125 inch.

(4) Bend the unformed tab of the locking strip down against the wheel while holding the formed tabs securely against the forward side of the wheel.

CAUTION

Do not use a sharp tool, steel bucking bar, or

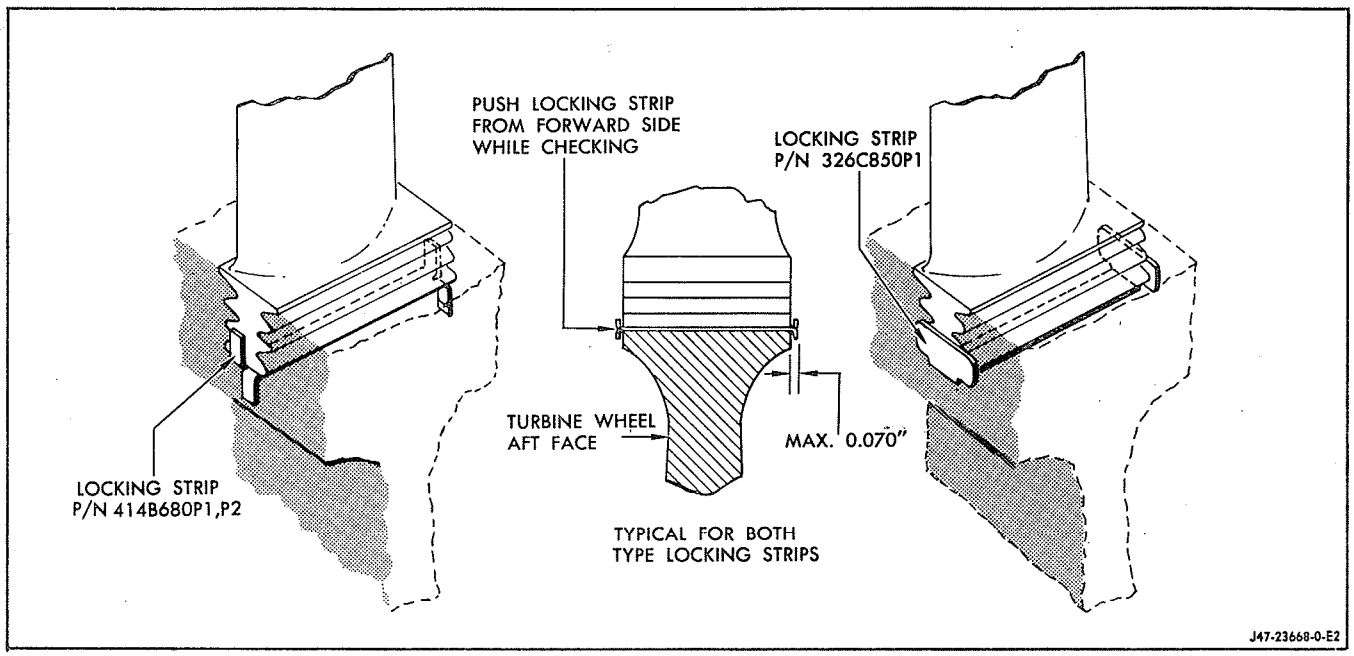


Figure 4-82. Locking Strip Assembled to Bucket

steel hammer to bend tabs. Tabs should be bent using an aluminum, fiber, or plastic mallet and bucking on the forward side with a brass bar or a bar of some similar material.

(5) After installation, check the bucket for tip shake. Tip shake must be between 0.000 and 0.125 inch. The locking strip tabs must not project from the turbine wheel rim face more than 0.070 inch when all play is accumulated at the measured end. (See figure 4-83.) Replace the bucket if any of these limits are exceeded.

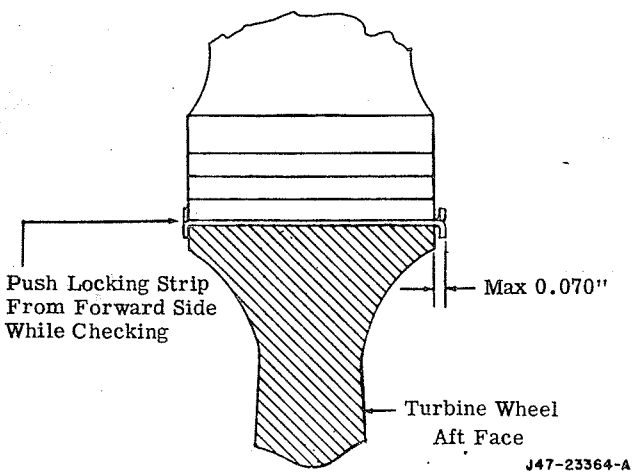


Figure 4-83. Checking Projection of Bucket Locking Strip

c. When the turbine wheel is installed on the engine, replace turbine buckets using locking strips as follows:

(1) Place the locking strip in the wheel serration with the 2 formed tabs to the forward face of the turbine wheel and the single formed tab down.

(2) Slide the bucket into the wheel serration and against the forward end of the locking strip tab.

(3) Check the bucket for tip shake. Tip shake should be between 0.016 and 0.125 inch before bending tab.

(4) Bend the unformed tab up against the aft dovetail of the turbine bucket while holding the formed tabs securely against the forward end of the wheel.

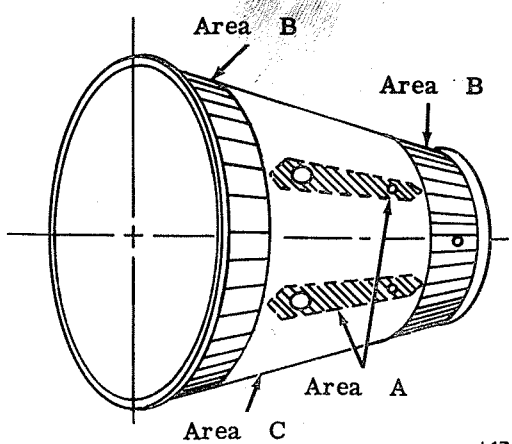


Figure 4-84. Welded Exhaust Cone Buckling Areas

CAUTION

Do not use a sharp tool, steel bucking bar, or steel hammer to bend tabs. Tabs should be bent using an aluminum, fiber, or plastic mallet. The formed tabs should be held securely against the wheel using brass stock or similar material.

4-167. INSPECTION AND REPAIR OF EXHAUST SECTION.

4-168. CHANNEL FAIRING EXHAUST CONE.

4-169. INSPECTION.

a. Inspect the exhaust cone assembly for cracks. Repair cracks as outlined in paragraph 4-170.

NOTE

All references to indices in this section are for figure 4-88A.

b. Inspect the outer cone (7) for buckling. Reform, if possible, buckling in excess of the following limits. (See figure 4-86.)

(1) Area A. Accept buckling within six inches of the forward and aft flanges up to a maximum depth of 5/16 inch and a minimum diameter across the buckle equal to six times the depth of the buckle.

(2) Area B. Accept buckling in any area other than area A up to a maximum depth of 1/2 inch and a minimum diameter across the buckle equal to six times the depth of the buckle.

c. Inspect the outer cone mounting flanges for nicks, dents and distortion. Rework nicks and dents. Rework distortion exceeding 1/8 inch as necessary to provide proper fit for installation.

d. Inspect the inner cone deflectors (cooling air cup) and air baffle for cracks or other damage. Replace deflectors if damage is beyond economical repair.

NOTE

Do not accept or attempt to repair cracks in the welded joint between the air baffle and deflector.

(1) Using a strong light and a dental mirror, inspect internal surfaces of cooling air tube (3) with special emphasis on weld joints. No cracks are allowed.

e. Inspect the inner cone (5) for axial and radial shifting.

(1) Accept axial shifting of the inner cone provided the limits in Section VIII, References 68, 69 and 70 are not exceeded.

(2) Accept radial shifting of 1/8 inch (1/4 inch total movement of the inner cone).

f. If inner cone axial or radial shifting exceeds acceptance limits, it is necessary to inspect and repair the support rods and tubes and their mating surfaces on the inner and outer cone. To accomplish this, disassemble the exhaust cone as follows:

(1) Remove the three tube support sleeves (14), four rod support sleeves (11), and cooling air adapter (8) by removing 32 screws and nuts. Remove fairing shrouds (17).

(2) Remove inner cone (5) and fairings (15) from outer cone (7).

(3) Remove forward sleeve support (9).

g. Remove air deflectors (1) and (2) by removing 16 bolts. Remove cooling air tube (3) by removing clamp (4).

h. Remove fairings, support rods (12), and support tubes (13) from inner cone as follows:

(1) Grind out the welds which secure the ends of the forward support tubes to the fairings.

(2) Remove fairing.

(3) Remove forward support tubes and aft support rods.

i. Inspect the cooling air tube (3) for damage. Replace the tube if damaged beyond economical repair.

j. Inspect the cooling air adapter (8) for wear on the tube portion and for cracks at the tube to adapter flange weld.

(1) Accept wear on end of tube (where it engages the inner cooling air tube) up to 0.025 inch (half of wall thickness). Replace adapter if wear exceeds limit, since no repair can be accomplished in this area.

(2) Accept wear on the tube barrel (where it rubs inner cone eyelet island fairings, etc.) up to 0.020 inch. Repair wear exceeding this limit provided it is not completely through (hole in tube wall). Replace adapter if a hole is worn in the tube wall.

(3) Repair cracks at or in the weld between the tube and adapter flange.

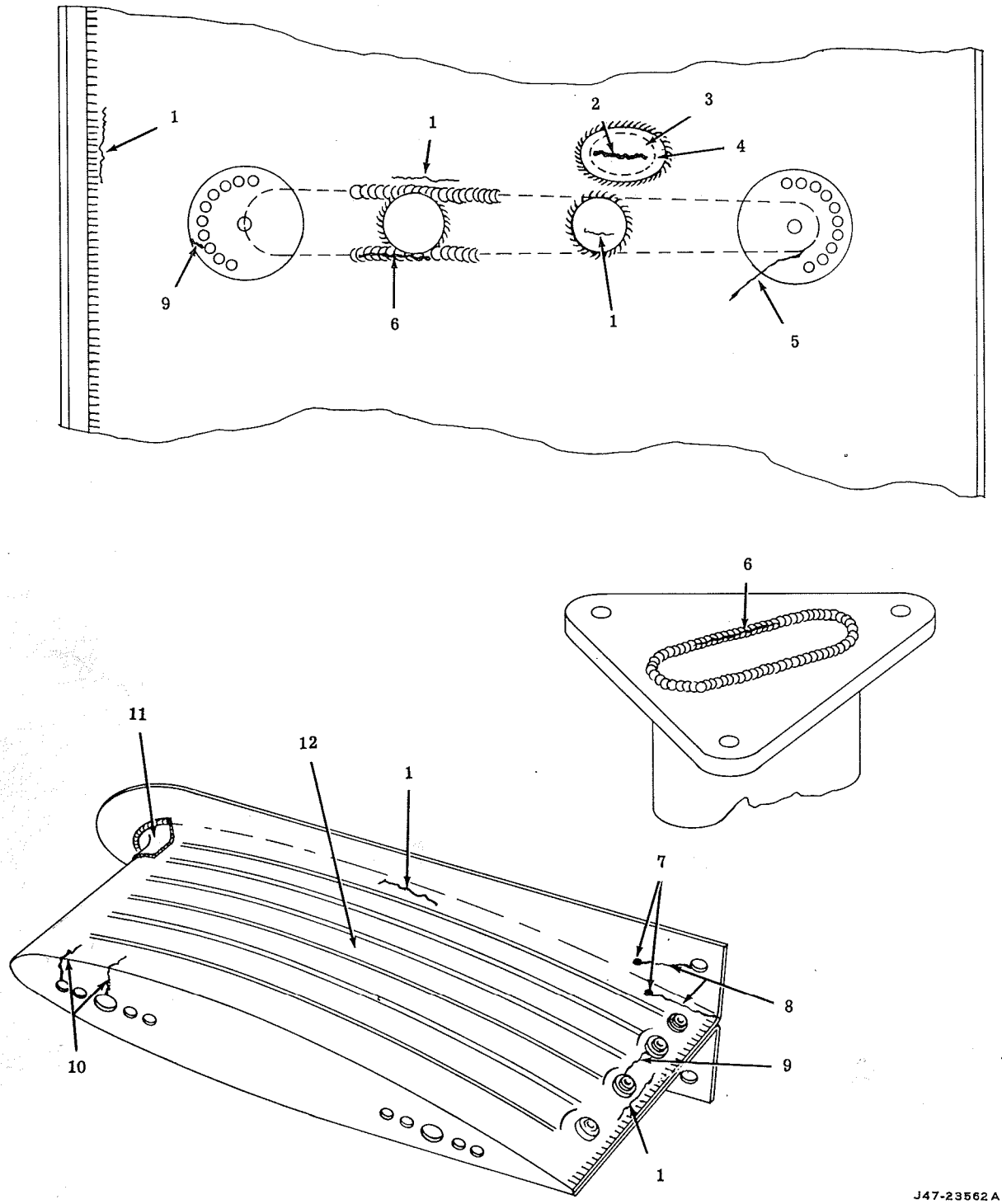


Figure 4-85. Welded Exhaust Cone Inspection Limits

k. Inspect the 8 support sleeves (9, 11, and 14), the 2 forward support tubes (13), and the 2 aft support rods (12) for wear.

(1) Accept wear on the forward support sleeves (9 and 14) if OD is not less than 0.750 inch. Replace forward support sleeve if wear exceeds limit.

(2) Accept wear on the aft support sleeve (11) if the ID is not over 0.825 inch. Replace aft support sleeve if wear exceeds limits.

(3) Accept wear in the ends of the forward support tubes (13) where they mate with the support sleeves if the ID is not over 0.825 inch. Replace forward support tubes if wear on ID exceeds limit. Accept wear on OD of support tubes where they mate with fairing and inner cone guide plate (16) if OD is not less than 0.986. Repair wear on OD exceeding this limit. Grind to original contour.

(4) Accept wear on end of the aft support rods (12) where they mate with support sleeves, if OD is not less than 0.425 inch.

(5) Accept wear on the aft support rod sleeves where they mate with the inner cone support plates, if the OD is not less than 0.605 inch. Repair in accordance with sub-paragraph "m".

l. Inspect fairing shrouds (P/N 303D153, 303D-154 and 303D155). Accept one crack per shroud running from bolt hole to outer edge, provided there are no other cracks emanating from the bolt hole and there are no other cracks which may converge to allow a piece to break free.

m. Inspect fairings for cracks.

n. The aft support rod ends and the permanently attached sleeves of the support rod shall be weld repaired by building up with metallic arc AMS 5681 electrodes or inert gas using AMS 5680 welding wire. Grind rod OD back to 0.438 inch and sleeve OD to 0.625 inch-tolerance of ± 0.005 inch.

4-170. REPAIR OF CHANNEL FAIRING EXHAUST CONE.

NOTE

Prior to welding on parts of the exhaust cone, note the general condition of the metal. If the overall condition of the metal in the part is such that repair is not economically possible, replace the part.

NOTE

Thoroughly clean the repair area or crack of carbon, grease, dirt and oxides before welding. Failure to do so may result in faulty welds.

a. Stop drill all cracks, use the proper welding process with the proper filler rod specified in Table VIII.

b. Condition A, figure 4-88. Repair weld circumferential cracks in the outer cone that have not spread (separation) in excess of 1/16 inch.

c. Condition B, figure 4-88. Cut out cracks in the parent metal accompanied by metal misalignment, distortion, burning or other damage in the outer cone not exceeding six inches in length and fillet weld a patch 0.045 inch thick, type 347 or 321 stainless steel to the outside surface. The patch must overlap the edge of the opening by 1/4 to 3/8 inch.

d. Condition C, figure 4-88. Grind out circumferential cracks in the butt welds at the forward and aft flanges up to a maximum length of 12 inches and spaced at least 24 inches apart, circumferentially, and repair weld.

e. Condition D, figure 4-88. Repair weld cracks in parent metal and in the seam welds of the inner cone.

f. Condition E, figure 4-88. Repair weld cracks in the fairing assemblies.

g. Re-form buckling in excess of acceptable limits for the outer cone skin provided the extent of re-forming does not develop cracks.

h. Re-form mounting flanges that are buckled, distorted, or out-of-round over 1/8 inch as necessary to provide proper alignment for installation. Remove nicks, dents, and high metal from mating surfaces of the mounting flanges with a stone or fine emery cloth.

i. Repair worn areas and cracked welds in the cooling air adapter (8) as follows:

(1) Repair of worn areas in tube portion.

(a) Mechanically clean worn area and remove feathered edges.

(b) Fill weld the worn area with 347 SS welding wire, using dc straight polarity, inert arc process. Wire brush and bench weld to within 0.030 inch of original contour. Remove splatter or flash from inside the tube.

NOTE

Use of a locally fabricated copper backup tool as shown in figure 4-85A (or equivalent) may be necessary to minimize tube distortion. Splatter or buildup inside the tube may be avoided if the tube wall is worn thin.

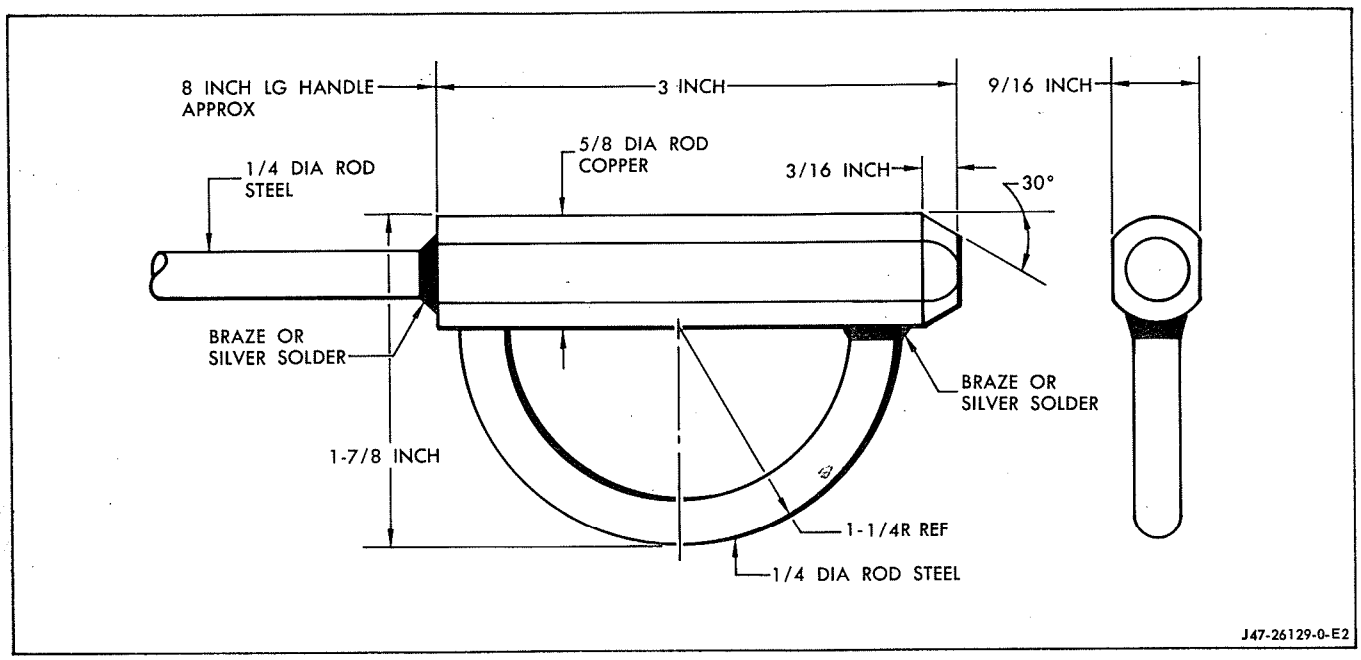


Figure 4-85A. Fixture for Cooling Air Adapter Tube Weld Repair

(c) Check for excessive distortion by inserting the tube in the mating part. If binding or interference is evident, remove the distortion by tapping with a brass, aluminum, or rawhide mallet.

(2) Repair of cracks at or in the weld.

(a) Mechanically clean and grind out cracks using a small grinder. (Note indentation in adapter plate at the weld area.)

(b) Fill weld cracks with 347 SS welding wire, using dc straight polarity, inert arc process. (Use copper backup tool if necessary.)

(c) To avoid installation difficulties, dress weld so it does not protrude above adapter plate. Remove splatter or flash from inside the adapter tube.

NOTE

When repairing weld cracks, make sure that the perpendicular relationship between the tube and adapter flange is maintained and the overall length is not less than 7.60 inches measured from the adapter flange surface.

4-170A. ASSEMBLY OF THE CHANNEL FAIRING EXHAUST CONE.

NOTE

Throughout this paragraph the numbers in parentheses refer to figure 4-88A except where stated otherwise.

a. Reassemble the inner cone as follows:

(1) Using new or serviceable support rods (12) and tubes (13) for alignment, install locally fabricated support bosses on the inner cone guide plates by welding. (See figure 4-85C, for boss fabrication and installation details.)

NOTE

Position support rod and tube on unworn surface of inner cone plates (16). Tack weld the bosses to the guide plates then remove the tubes and rods. Complete the fillet weld. (In some cases, it will not be possible to weld bosses around their entire circumference.) Use copper backup and carefully regulate heat to avoid distortion. After welding, forward and rear holes may require reaming to obtain proper fit.

Figure 4-85B. Deleted

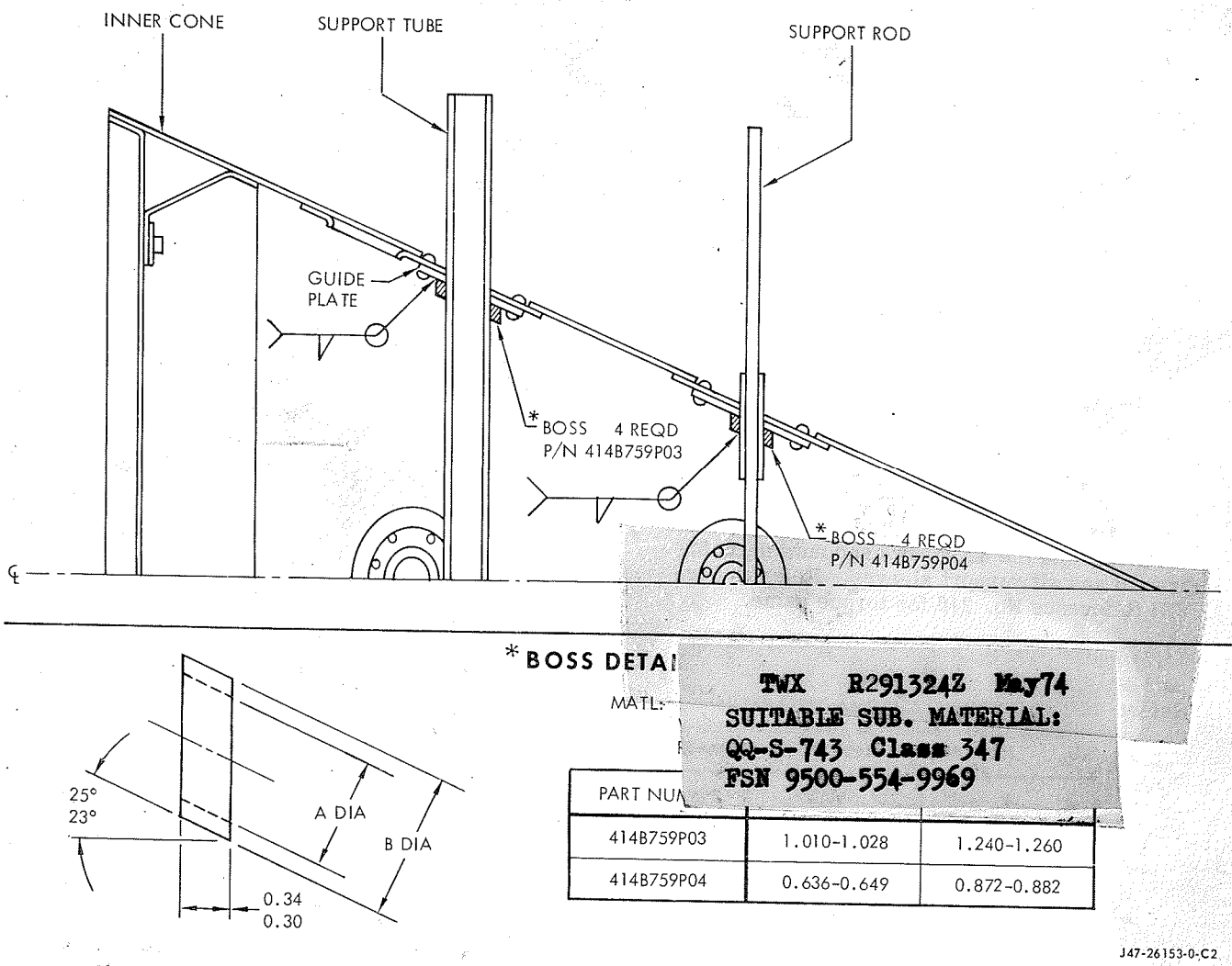


Figure 4-85C. Exhaust Cone Boss Installation Detail

(2) With support rods (12) and tubes (13) positioned in the inner cone, install 4 plastic shims, P/N 611A514P1, on each end of the aft support rods.

(3) Install 4 fairings (15) on the protruding support rods and tubes.

(4) Holding the fairings tightly against the shims, weld the fairings to the forward support tubes.

NOTE

Shift tube as required to assure equal extensions through the fairing before welding.

(5) Install cooling air tube support sleeve (9) making certain support tube is engaged by support sleeve.

(6) Shift rear support rod as necessary for equal extension on each end. Install inner cone (3) to the outer cone (7).

NOTE

The cooling air tube support sleeve (9) which aligns with the cooling air patch location, is installed on inner side of the outer cone.

(7) Install three support sleeves (14) to the outer side of the forward patch locations on the outer cone. Make certain the support tubes are engaged by the support sleeves. Position fairing shrouds (17) and secure loosely using 4 screws and nuts at each end of the three support sleeves (14) location.

(8) Install the cooling air tube (3) to the inner cone and secure to the support tube with one clamp

(4) and one nut and bolt. Torque to value in Section VIII, Table XLII.

(9) Install the cooling air adapter (8) to the cooling air patch. The adapter engages cooling air tube (3).

(10) Hold the remaining fairing shrouds in place, secure cooling air adapter (8) tube support (9) and the fairing shroud (17) to the cone using the 4 long screws and nuts.

(11) Install 4 rod support sleeves (11) to the aft patches making certain rod ends engage the inside diameter of the support sleeves.

(12) Install bracket (10) to the aft patch directly behind the cooling air adapter.

(13) Secure the support sleeves to the outer cone using 4 screws and nuts on each.

(14) Torque the 32 screws and nuts securing the forward and aft support sleeves. Refer to Section VIII Reference No. 216 for torque value.

(15) Install nut plate sectors (6) on the inner cone and secure with 2 bolts each. Refer to Section VIII Reference No. 217 for torque value.

(16) Install the cooling air deflector (2) and the outer air deflector (1) to the inner cone making certain air deflector engages cooling air tube (3). Secure with 16 bolts. Refer to Section VIII Reference No. 218 for torque value.

CAUTION

Do not machine or grind into the seam weld on the forward flange of the inner cone. Position the inner cone forward as far as possible when measuring dimensions as specified in reference Nos. 68, 69 and 70, Section VIII, because the inner cone tends to move forward (toward turbine wheel) during engine operation.

b. After repair and disassembly of the exhaust cone check axial dimensions, Section VIII Reference Nos. 68, 69 and 70. Machine or grind the inner cone flange and baffle if necessary, to bring the dimensions within limits.

c. Unless already accomplished modify exhaust cones by fill welding holes in inner cone skin and by drilling holes in the cooling air deflector as shown on figure 4-88B.

4-171. WELDED-TYPE EXHAUST CONE.

4-172. INSPECTION.

a. Inspect the exhaust cone for cracks. Accept without repair, cracks in the trailing edge of the fairings not exceeding 1/4 inch in length. Cracks in the trailing edge of the fairing that may converge, causing a piece to break out must be weld repaired. All other cracks in the exhaust cone assembly must be repaired as outlined in paragraph 4-173.

NOTE

All repair on the exhaust cone will be made with the exception of those that involve disassembly of the exhaust cone.

b. Inspect the outer cone for buckling. Reform, if possible, buckling in excess of the following limits. (See figure 4-84.)

(1) Area A. Accept buckling within the area of the spot weld patterns up to a maximum depth of 1/4 inch and a minimum diameter across the buckle equal to six times the depth of the buckle.

(2) Area B. Accept buckling within six inches of the forward and aft flanges up to a maximum depth of 5/16 inch and a minimum diameter across the buckle equal to six times the depth of the buckle.

(3) Area C. Accept buckling in any area other than Area A or B up to a maximum depth of 1/2 inch and a maximum diameter across the buckle equal to six times the depth of the buckle.

c. Inspect the outer cone mounting flanges for nicks, dents, burrs, and distortion. Rework nicks, dents and burrs. Rework distortion in excess of 1/8 inch as necessary to facilitate installation.

d. Inspect the inner cone deflectors (cooling air cup) and air baffle for cracks or other damage. Replace deflectors if damage is beyond economical repair.

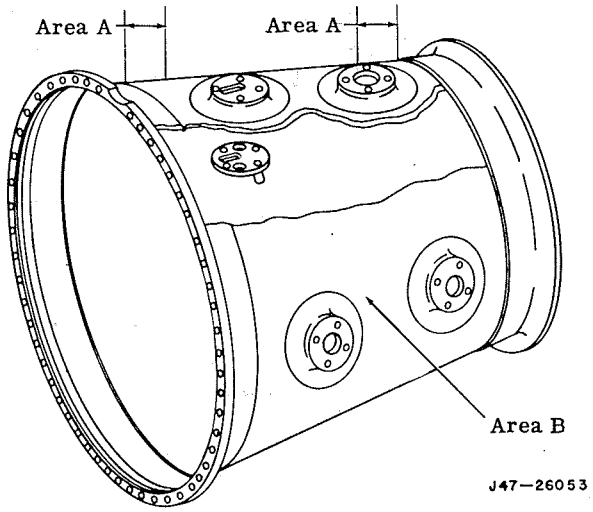


Figure 4-86. Channel Fairing Exhaust Cone Buckling Limits

Figure 4-87. Deleted

(1) Using a strong light and a dental mirror, inspect internal surfaces of cooling air tube (3) with special emphasis on weld joints. No cracks are allowed.

NOTE

Do not accept or attempt to repair cracks in the welded joint between the air baffle and deflector.

e. Inspect the inner cone for axial and radial shifting.

(1) Accept axial shifting of the inner cone provided the limits in Section VIII, References 68, 69 and 70 are not exceeded.

(2) Accept radial shifting of 1/8 inch (1/4 inch total movement of the inner cone).

f. Inspect the cooling air tube, part No. 9451321, as follows:

(1) Remove the adapter, part No. 9451459.

(2) With a flashlight and metal probe inspect the cooling air tube for worn holes and disengagement at the sliding joint.

NOTE

Probe should be 12 to 15 inches long with approximately 1/2 inch at one end bent 90 degrees. Apply hand pressure on the probe to determine if the wall is sound. A very thin wall wear area may not show from inside, but applying hand pressure on the probe may cause a breakthrough or deformation of the tube wall in the worn area. Special attention should be given to an area on the aft side of the tube approximately 6-1/2 inches down from the connector flange since wear usually occurs in this area.

(3) If holes, breakthrough, or deformation is detected or occur during inspection, replace the exhaust cone assembly.

4-173. REPAIR OF WELDED EXHAUST CONE.

NOTE

Prior to welding on exhaust cones, note the general condition of the metal. If the overall condition of the metal in the exhaust cone is such that repair is not economically possible, replace the exhaust cone.

NOTE

Thoroughly clean the repair area or crack of carbon, grease, dirt and oxides before welding. Failure to do so may result in faulty welds.

a. Stop drill all cracks, use the proper welding process with the proper filler rod specified in Table VIII.

b. Repair weld circumferential or longitudinal cracks in the outer cone (A and B, figure 4-85) that have not spread in excess of 1/16 inch.

c. Cut out cracks in the parent metal accompanied by metal misalignment, distortion, burning or other damage in the outer cone (C, figure 4-85) not exceeding six inches in length, and fillet weld a patch 0.045 inch thick, type 347 or 321 stainless steel to the outside surface. The patch must overlap the edge of the opening by 1/4 to 3/8 inch.

d. Repair outer cone surface cracks (D, figure 4-85) which extend beyond the riveted patch by removing the patch, weld the crack, and replace patch using AN435M4-6 rivets.

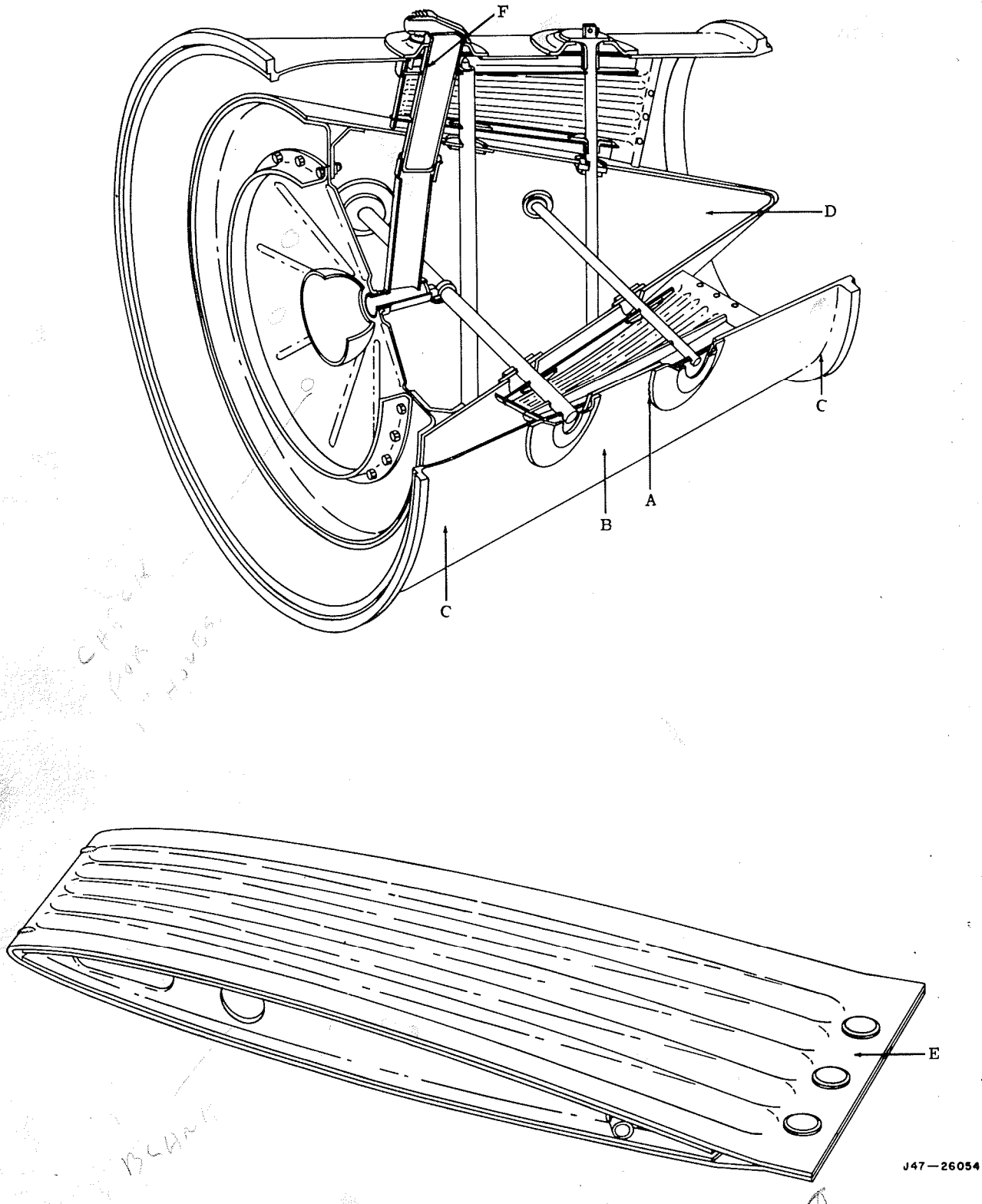


Figure 4–88. Channel Fairing Exhaust Cone Inspection Locations

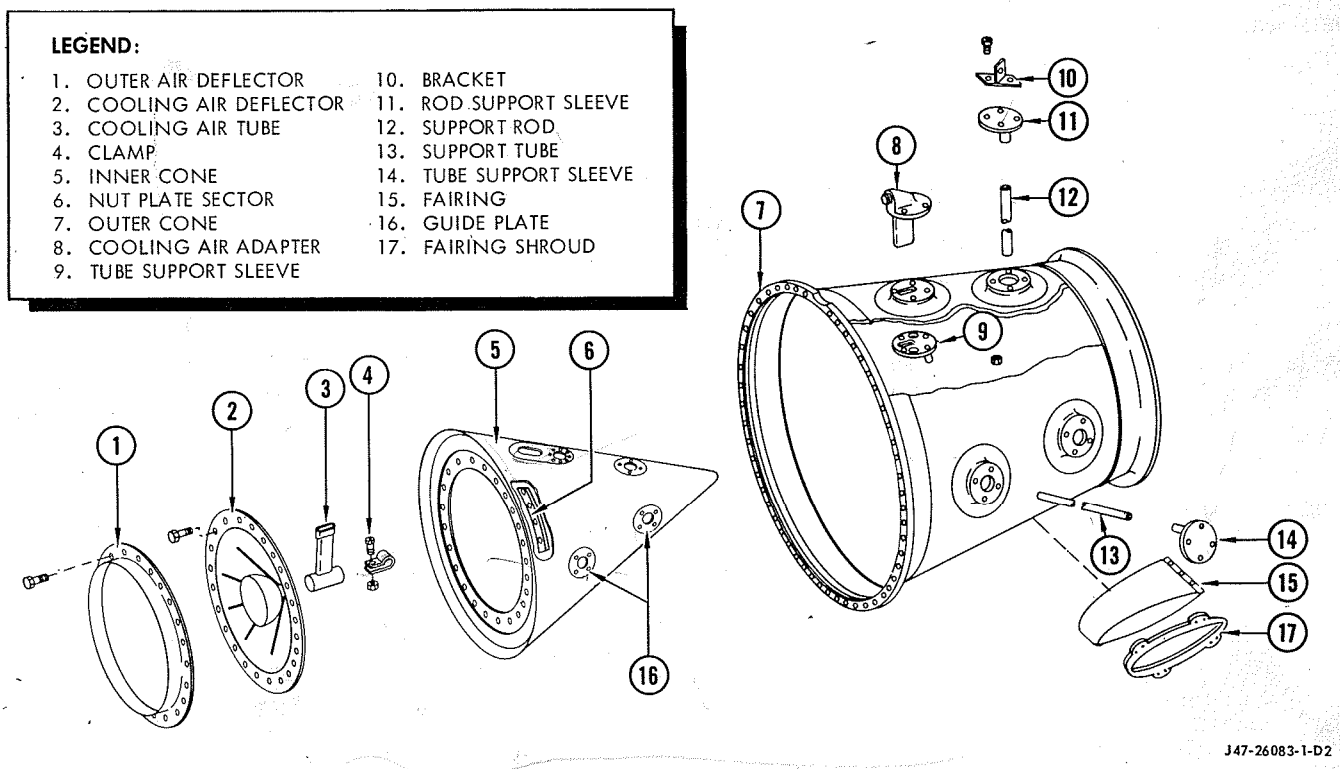


Figure 4-88A. Channel Fairing Exhaust Cone, Exploded View

e. Repair weld cracks in the support rod pads (E, figure 4-85) which are welded to the outer cone surface, or cracks of the outer cone emanating from the pads and not exceeding one inch beyond the pad. Remove the patch when cracks exceed one inch, before welding.

f. Repair weld cracks in the fairings (F, figure 4-85) as indicated in preceding steps b and c. Cracks that extend into or through rivet hole require removal of the rivet prior to welding. A maximum of two repairs are permitted each side of the fairing.

g. Repair weld cracks adjacent to spot weld attaching fairing to the outer cone that have not spread in excess of 1/16 inch.

h. Repair weld cracks that occur in the fillet weld (G, figure 4-85) of the cooling air inlet flange to the cooling air tube.

i. Repair weld cracks progressing from the rivet holes (H, figure 4-85) or in the fillet at the trailing edge of the fairing.

j. Repair weld cracks adjacent to the seam weld (J, figure 4-85) on the trailing edge of the fairing.

k. Repair weld circumferential cracks up to 360 degrees in length in the forward area of the inner cone that do not extend aft of the seam weld in excess of one inch. Repair weld cracks in the inner cone tip.

NOTE

Grind out cracks in the inner cone to a depth of 0.020 inch prior to welding.

l. Replace air deflectors by grinding out welds holding 3 sectors, and rewelding new or serviceable deflectors in place.

CAUTION

Do not machine or grind into the seam weld on the forward flange of the inner cone. Position the inner cone forward as far as possible when measuring dimensions as specified in reference Nos. 68, 69 and 70, Section VIII, because the inner cone tends to move forward (toward turbine wheel) during engine operation.

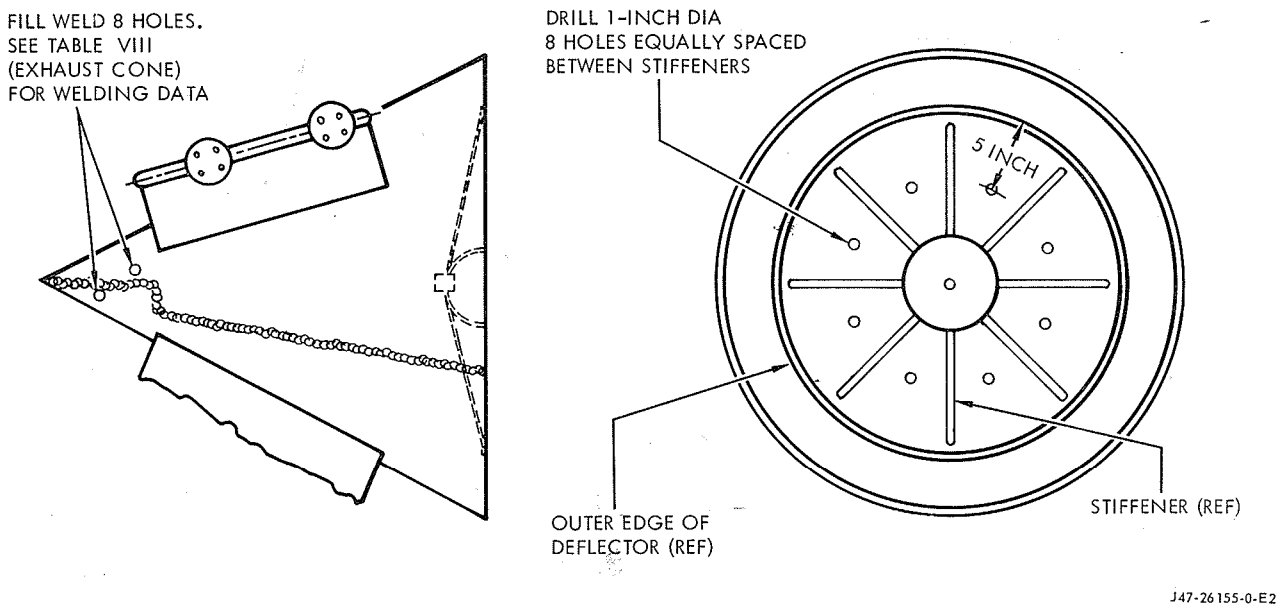


Figure 4-88B. Modification of Exhaust Cone

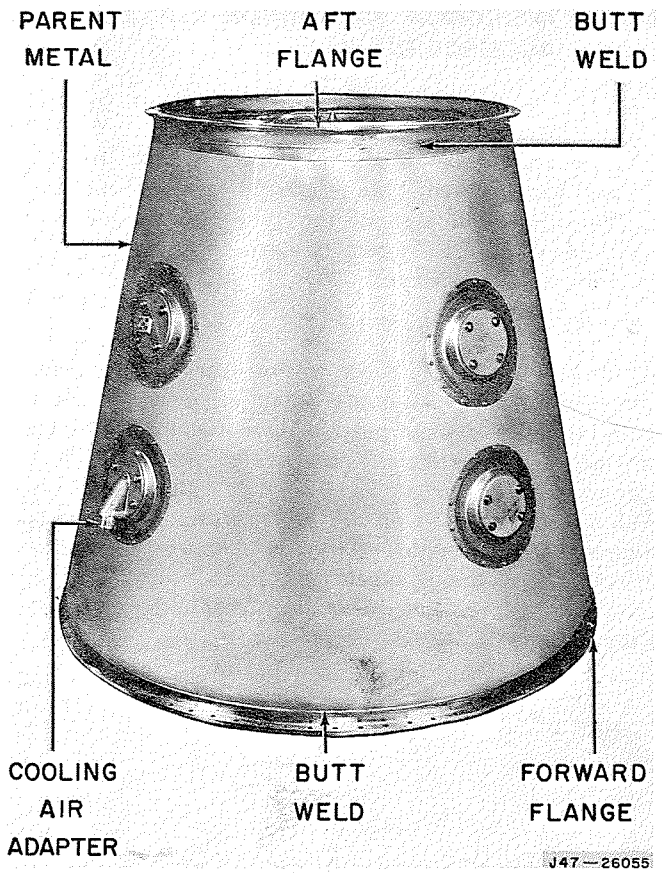


Figure 4-89. Channel Fairing Exhaust Cone Repair Locations

m. When the axial dimensions from the inner exhaust cone inner and outer baffles to the forward mounting flange of the outer cone are less than those listed in Section VIII, reference Nos. 68, 69, and 70, machine or grind deflectors until the dimensions are within limits.

n. Remove buckling in excess of acceptable limits for the exhaust cone by re-forming provided the extent of re-forming does not develop cracks.

o. Re-form exhaust cone mounting flanges that are distorted, buckled, or out-of-round more than 1/8 inch as necessary to provide proper fit or alignment for installation. Remove high metal from nicks, dents, and burrs on mounting flange mating surfaces with a stone or fine emery cloth.

p. Modify outer exhaust cones with thermocouple bosses as follows:

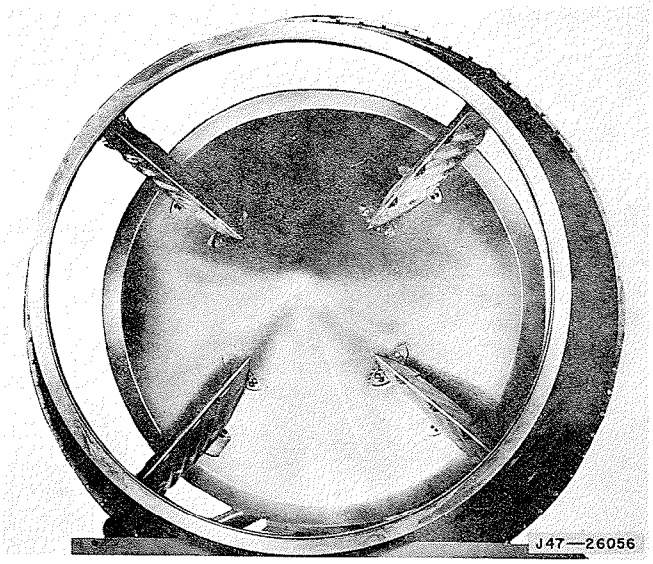


Figure 4-90. Rear View of Channel Fairing Exhaust Cone

Figure 4-91. Deleted

Figure 4-92. Deleted

(1) Cut off the thermocouple boss flush with the outer cone surface.

(2) Locally fabricate a patch from 0.0625 inch thickness stainless steel AMS 5512 or equivalent, approximately 1-1/8 inches in diameter and fillet weld patch over the opening.

q. If exhaust cones have not been modified by the addition of bracket P/N 8495660, perform this modification by welding additional bracket P/N 8495660, back-to-back with the presently installed single bracket.

NOTE

Align holes in the brackets prior to welding.

r. Unless already accomplished, modify exhaust cones by fill welding holes in inner cone skin and by drilling holes in the cooling air deflector as shown on figure 4-88B.

4-174. Deleted.

4-175. Deleted.

4–176. INSPECTION AND MINOR REPAIR OF ACCESSORIES.

Note

The accessories of the air inlet system, the anti-icing system, the electrical system, the fluid injection system, the fuel system, and the lubrication system are covered in the following paragraphs.

4–177. LOW TENSION LEADS.

4–178. GENERAL. The low tension leads are the leads that conduct normal aircraft potential, generally 24 v dc or 110 v ac, or some portion thereof. For additional information or particulars not covered in this section, refer to Section XII of T.O. 1–1A–8. Numerous low tension leads are used on the J47 engines. These leads (figures 4–93 through 4–98) are described, together with particular minor repair techniques. Minor repair instructions are provided for low tension leads listed in table XX.

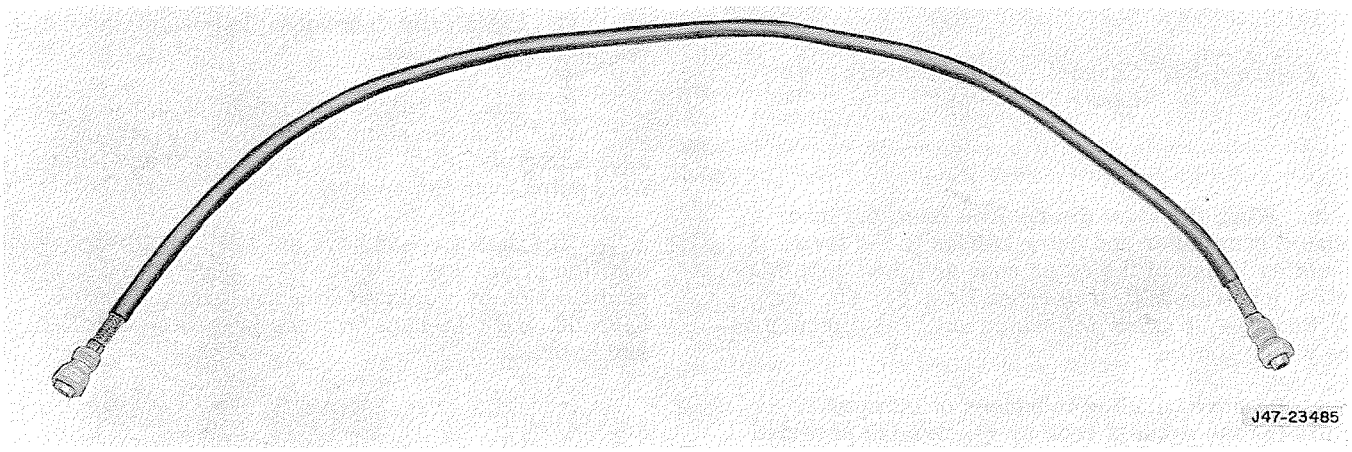


Figure 4–93. Tachometer Generato Lead P/N 131B275

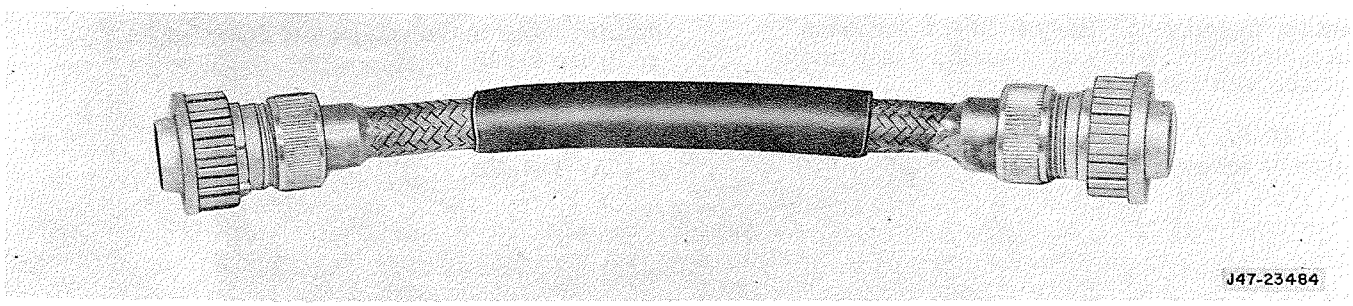


Figure 4–94. Inlet Screen Actuator Lead P/N 131B276

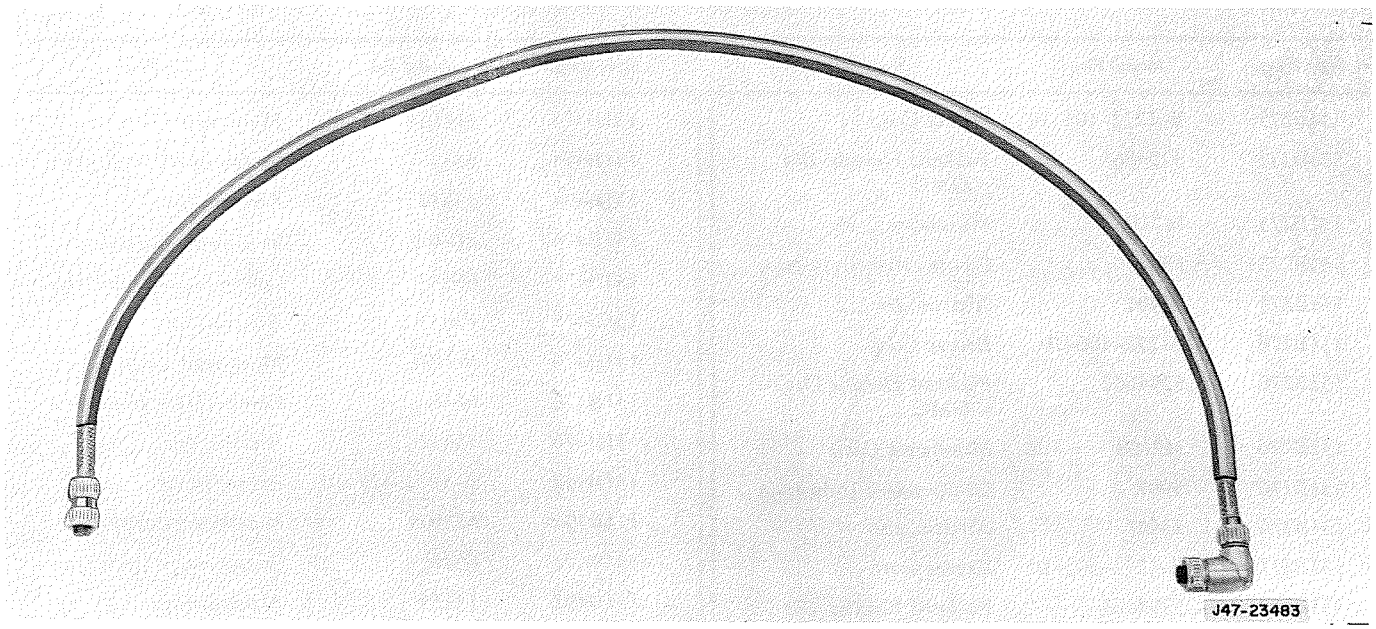


Figure 4–95. Anti-Icing Valve Lead P/N 131B277

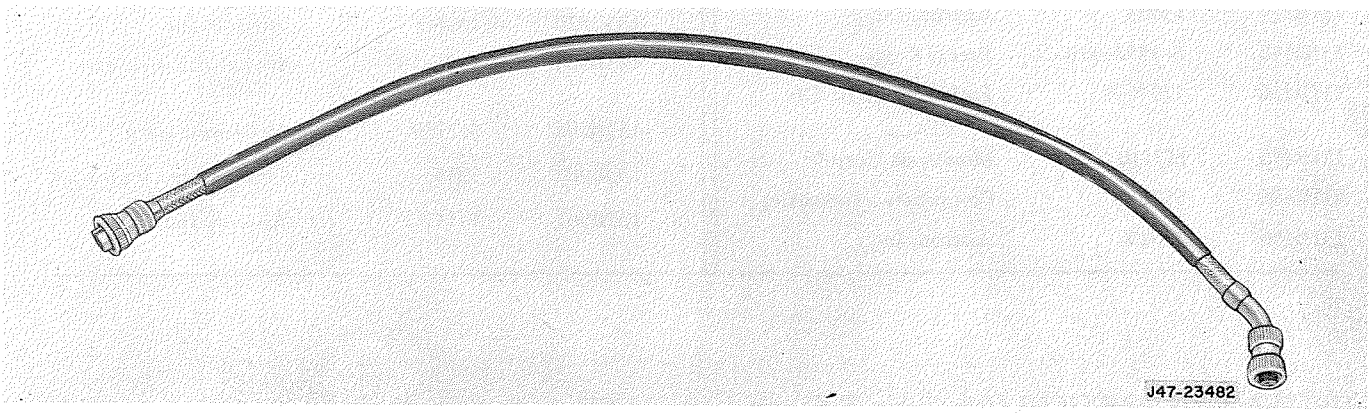


Figure 4–96. Vibrator Lead P/N 131B456

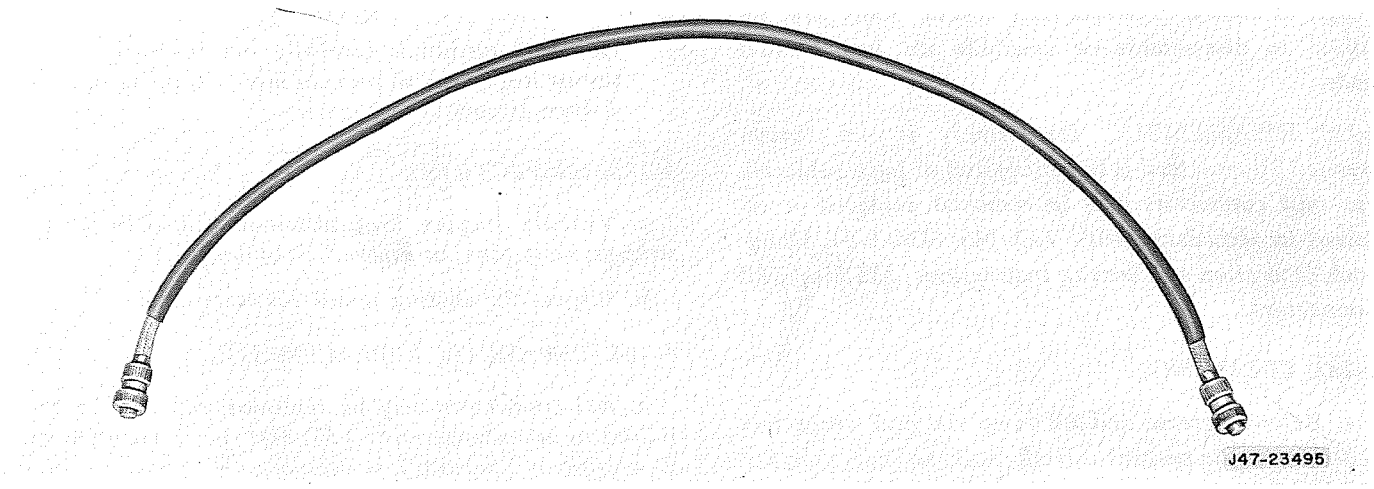


Figure 4–97. Anti-Stall Valve Cable P/N 133B984

TABLE XX. LOW TENSION LEADS

Spec Dwg.	Model No.	Supplier
131B275	E–1272–104–10	Breeze Corp
131B275	5294661	Packard Electric Div GMC
131B275	M7106	Monowatt Corp
131B275	5906	Co-operative Industries
131B275	13401	Airtron, Inc
131B276	E1272–106–10	Breeze Corp
131B276	5294662	Packard Electric Div GMC
131B276	M7108	Monowatt Corp
131B276	5907	Co-operative Industries
131B276	13402	Airtron, Inc
131B277	E–1272–103–10	Breeze Corp
131B277	5294663	Packard Electric Div GMC
131B277	M7104	Monowatt Corp
131B277	5908	Co-operative Industries
131B277	13403	Airtron, Inc
131B456	E–1272–110–10	Breeze Corp
131B456	5294668	Packard Electric Div GMC
131B456	M7110	Monowatt Corp
131B456	6522	Co-operative Industries
131B456	13620	Airtron, Inc
131B474	M7103	Monowatt Corp
131B474	6637	Co-operative Industries
131B474	13634	Airtron, Inc
131B475	M7109	Monowatt Corp
131B475	6638	Co-operative Industries
131B475	13633	Airtron, Inc
131B476	M7101	Monowatt Corp
131B476	6635	Co-operative Industries
131B476	13632	Airtron, Inc
131B492	E–1272–127–10	Breeze Corp
131B492	M7105	Monowatt Corp
131B492	6636	Co-operative Industries
131B492	13459	Airtron, Inc
133B633	M7114	Monowatt Corp
133B633	6883	Co-operative Industries
133B633	13800	Airtron, Inc
133B829	13966	Airtron, Inc
133B984	5298859	Packard Electric Div GMC
133B984	M7130	Monowatt Corp
133B984	7355	Co-operative Industries
133B984	14157	Airtron, Inc

4–179. LEADING PARTICULARS. Table XXI contains the leading particulars of the various low tension leads used on the J47 engines.

4–180. SPECIAL TOOLS. No special tools are required to disassemble or assemble the low tension leads.

4–181. DISASSEMBLY. Disassembly is not recommended unless a lead is to be repaired or parts replaced. Pin type connectors may be removed, replaced or repaired in accordance with T.O. No. 8D4–1–31, Handbook Operation and Service Instructions, AN Electrical Connectors.

4–182. CLEANING.

a. Remove grease and oil from the end connectors with a suitable neutral solvent, such as Federal Specification P–S–661.

b. Clean all electrical connector lugs or pins with a fine abrasive paper or cloth. Remove all loose particles with a soft brush.

Note

Dry lead terminals carefully before further test or inspection to prevent any possibility of a short circuit.

4–183. INSPECTION.

a. Visually inspect lead terminals for damage to threads, bent pins, or cracked insulators.

b. Inspect the chafing guard for tears or frays.

4–184. REPAIR OR REPLACEMENT.

a. AN connectors may be removed, replaced or repaired in accordance with T.O. 8D4–1–31, Handbooks Operation and Service Instructions, AN Electrical Connectors.

TABLE XXI. LEADING PARTICULARS OF LOW TENSION LEADS

Table of Leading Particulars

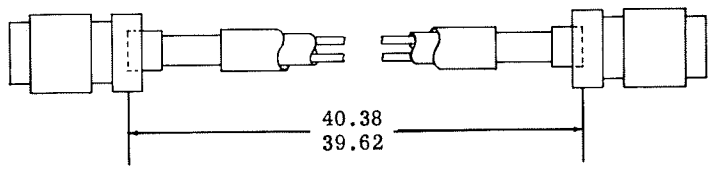
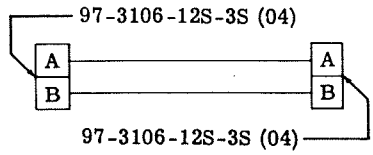
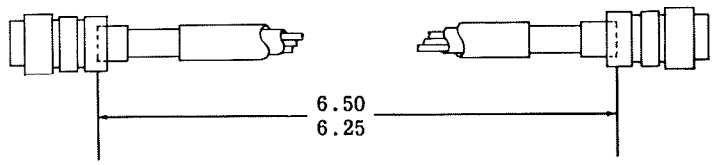
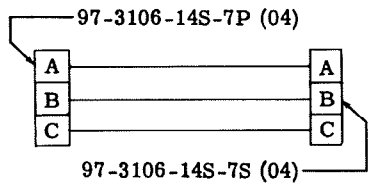
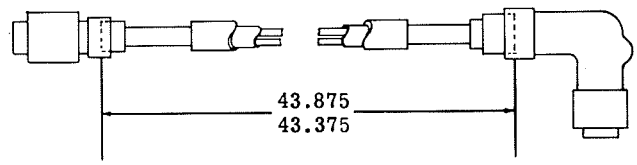
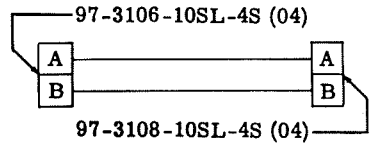
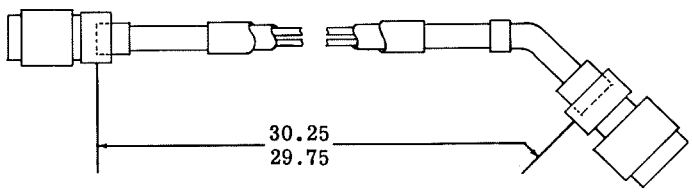
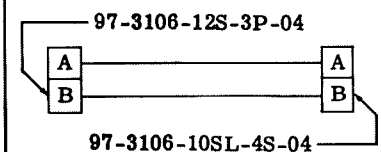
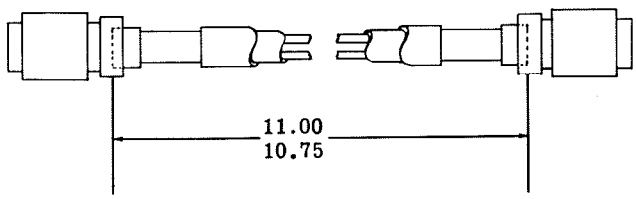
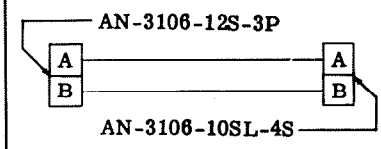
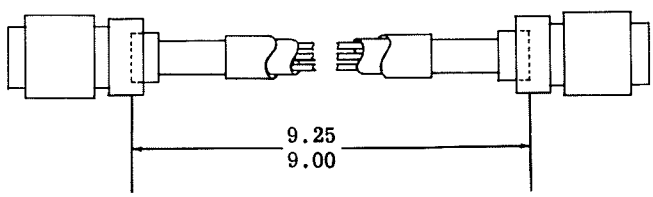
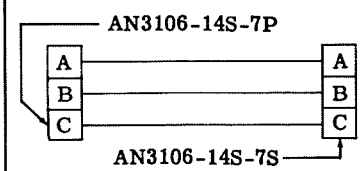
Spec Dwg Number	Lead Length	Wiring Diagram
131B275		
131B276		
131B277		
131B456		
131B474		
131B475		

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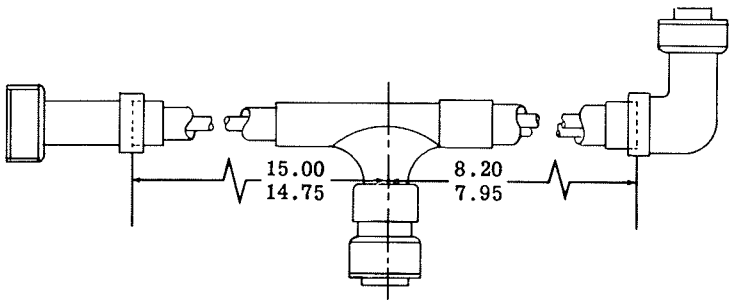
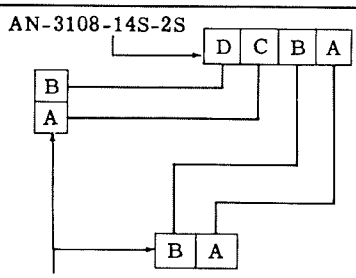
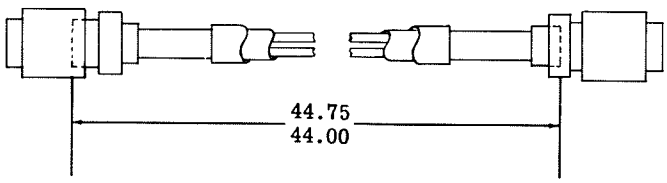
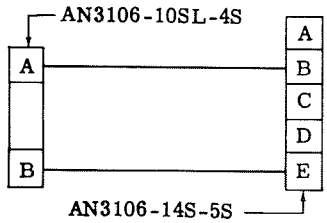
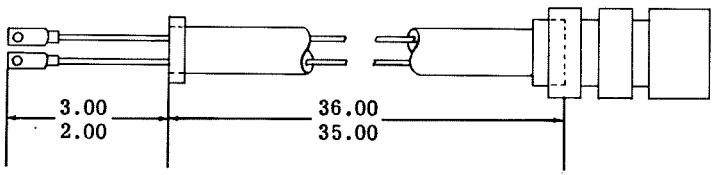
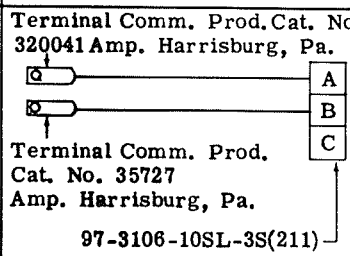
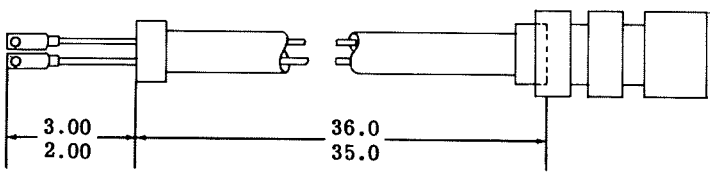
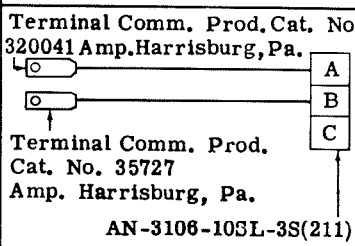
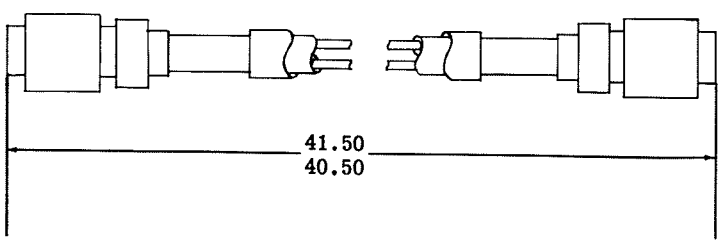
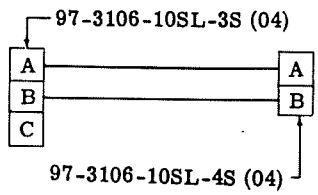
TABLE XXI. LEADING PARTICULARS OF LOW TENSION LEADS (cont)

Table of Leading Particulars

Spec Dwg Number	Lead Length	Wiring Diagram
131B476		 (Same as AN3106-105L-4S Less Threaded Conduit Adapter)
131B492		
133B633		
133B829		
133B984		

J47-23481

b. When a portion of the rubber chafing guard is torn, cut, or frayed, it may be cut out and removed. Leads with the chafing guard completely or partially removed are still serviceable.

Note

Do not use electrical tape to repair chafing guard.

Note

Low tension leads with the chafing guards severely damaged or removed are still serviceable.

4–185. LUBRICATION.

a. No lubrication is required.

4–186. REASSEMBLY.

a. If AN Connectors were disassembled for repair, re-assemble with replaced or repaired parts.

4–187. TEST PROCEDURE.

a. Insulation Resistance.

(1) Measure the resistance between each wire and all others, and between each wire and the cable shield (ground), with 250 volts dc applied. The measured resistance must not be less than 10 megohms.

Figure 4–98. Deleted

Note

Insulation resistance may be checked using a 500 volt megger.

b. Continuity Test.

(1) Test wiring of the leads and cables for continuity in accordance with the applicable wiring diagram. Cables may be tested for continuity using a Simpson Meter or other type of continuity checker. Cables or leads which are not in conduit, but which are protected by braided shielding, should be flexed during these tests to detect any shorts caused by broken braid ends piercing the wire insulation.

4–188. HIGH TENSION LEADS.

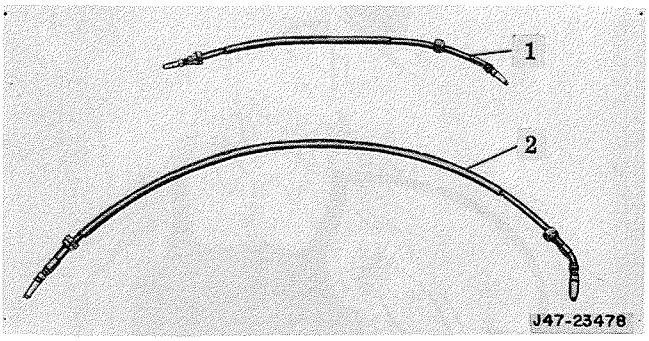
4–189. GENERAL. The high tension leads conduct high potentials, generally 10,000 or 20,000 volts. These leads are normally designed to withstand a minimum potential of 20,000 volts and to operate satisfactorily in a temperature of 260°C (500°F). Minor repair procedures and techniques for the following high tension leads are described herein: (See figure 4–99 and table XXII.)

4–190. LEADING PARTICULARS. Leading particulars of the high tension leads are shown in table XXIII.

4–191. SPECIAL TOOLS. No special tools are required to disassemble or assemble the high tension leads.

4–192. DISASSEMBLY. Disassembly is not recommended.

4–193. CLEANING. Grease and oil must be removed from the end connectors of the leads using a suitable neutral solvent, such as Federal Specification P–S–661.



1. Part No. 131B526–3 2. Part No. 131B526–4

Figure 4–99. Ignitor Plug Leads

TABLE XXII. HIGH TENSION LEADS

Spec Dwg.	Model No.	Supplier
131B279–1	13408	Airtron, Inc
131B279–1	5910	Co-operative Industries
131B279–2	13409	Airtron, Inc
131B279–2	5911	Co-operative Industries
131B279–3	13410	Airtron, Inc
131B279–3	5912	Co-operative Industries
131B279–4	13411	Airtron, Inc
131B279–4	5913	Co-operative Industries
131B526–1	1GC6Z367	G. E. Co
131B526–1	5296140	Packard Electric Div GMC
131B526–1	6541	Co-operative Industries
131B526–1	13694	Airtron, Inc
131B526–3	1GC6Z368	G. E. Co
131B526–3	5296141	Packard Electric Div GMC
131B526–3	6543	Co-operative Industries
131B526–3	13696	Airtron, Inc
131B526–4	1GC6Z369	G. E. Co
131B526–4	5296142	Packard Electric Div GMC
131B526–4	6544	Co-operative Industries
131B526–4	13697	Airtron, Inc

Note

Dry leads carefully before further testing and inspection to prevent flashover.

4–194. INSPECTION. Inspect as follows: (See figure 4–100.)

a. Carefully examine lead terminals. If serious scores, cracks, or other defects are noted, replace the entire assembly.

b. Examine the contact spring in the spring connector for good spring resiliency. The contact spring should be firmly fixed to the connector.

c. Inspect the chafing guard for tears or frays.

4–195. REPAIR OR REPLACEMENT.

a. The contact spring may be stretched and adjusted to insure good electrical contact.

b. When a portion of the rubber chafing guard is torn, cut, or frayed, it may be cut out and removed. Leads with the chafing guard completely or partially removed are still serviceable.

Note

Do not use electrical tape to repair chafing guard.

Note

High tension leads with the chafing guards severely damaged or removed are still serviceable.

4–196. TEST PROCEDURE.

a. Continuity Test:

(1) Check continuity for breaks in the insulated cable.

b. High Potential Test: (See figure 4–102.)

(1) Apply 20,000 volts peak between the lead and the braided conduit for one minute. Breakdown or leakage shall be cause for rejection. During this test, both ends of the lead may be immersed in Dow Corning No. 200 fluid to prevent possible flash over at the lead terminals.

WARNING

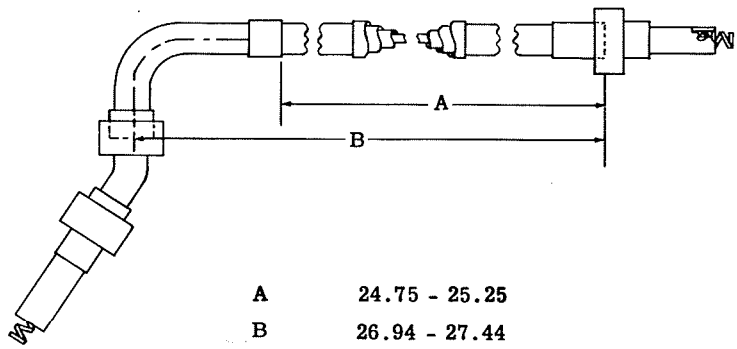
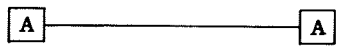
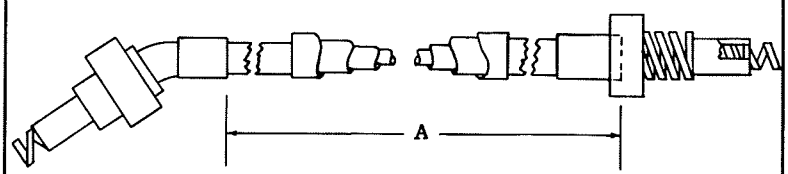
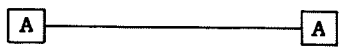
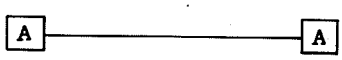
Protect the operator by securing the equipment in a closed box with interlocks so that there is no danger of electrical shock. Be sure to insulate the mechanism of varying the variable spark gap.

4–197. NO. 1. ISLAND CABLE ASSEMBLY.

4–198. GENERAL. The No. 1 island cable assembly (figure 4–103) is used only on the J47–27 engine to accumulate the forward accessory section electrical leads in a junction box on the island itself, and then to conduct these electrical leads to the main engine junction box. There are 5 cables going from the island junction box into the accessory section. These are: the accessory fire detector lead, the starter-generator shunt field lead, the tachometer generator lead, the anti-icing thermostat lead, and the fuel flow transmitter lead. Two cables go from the island junction box and connect to the main engine junction box. The following paragraphs contain minor repair instructions for the No. 1 cable assemblies listed below.

TABLE XXIII. LEADING PARTICULARS OF HIGH TENSION LEADS

Table of Leading Particulars

Spec Dwg Number	Lead Length	Wiring Diagram
131B279-1	 A 24.75 - 25.25 B 26.94 - 27.44	
131B279-2	A 19.06 - 19.56 B 21.25 - 21.75	
131B279-3	A 17.50 - 18.00 B 19.70 - 20.20	
131B279-4	A 33.75 - 34.25 B 35.95 - 36.45	
131B526-1	 A 24.00 - 24.50	
131B526-2	A 18.75 - 19.25	
131B526-3	A 20.25 - 20.75	
131B526-4	A 38.25 - 38.75	

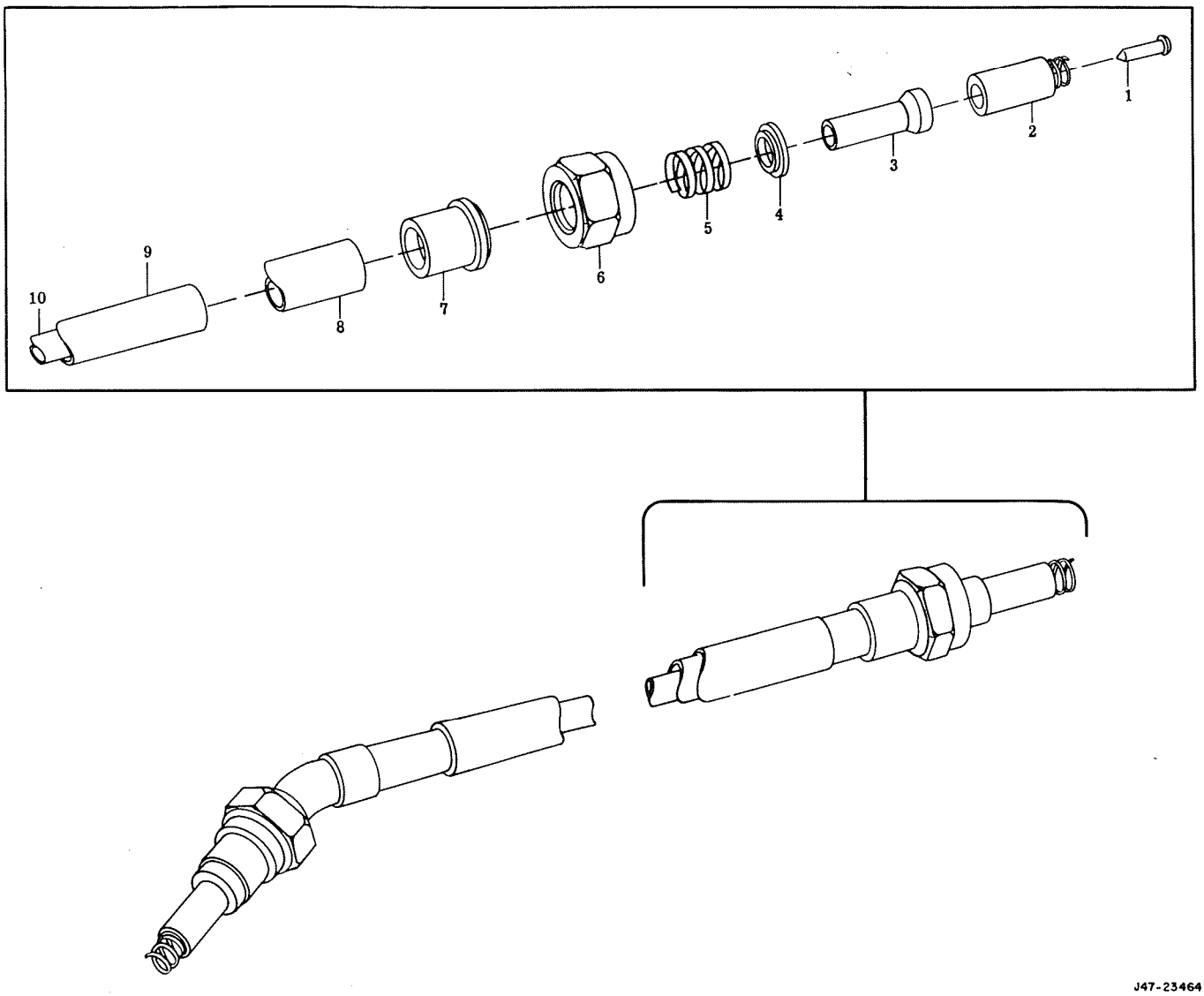
J47-23460

Spec Dwg.	Model No.	Supplier
508E403	11129	Airtron, Inc
508E403	M7201	Monowatt Corp
508E403	6821	Co-operative Industries
508E635	11210	Airtron, Inc
508E635	M7215	Monowatt Corp
508E635	7714	Co-operative Industries

4–199. LEADING PARTICULARS. Leading particulars for the No. 1 island cable assembly are shown in table XXIV.

4–200. SPECIAL TOOLS. No special tools are required to disassemble or assemble No. 1 island cable assembly.

4–201. DISASSEMBLY. Unless one of the cable leads is to be repaired or replaced, disassembly is not recommended. Cable Amphenols may be removed, replaced, or repaired in accordance with T.O. No. 8D4–1–31, Handbook of Operation and Service Instructions, AN Electrical Connectors.



1. Pin
2. Connector
3. Grommet
4. Ferrule
5. Spring
6. Nut
7. Ferrule
8. Sleeve
9. Conduit
10. Cable

Figure 4–100. Exploded View, Typical High Tension Terminal

Figure 4–101. Deleted

4–202. CLEANING. Clean grease and oil from the junction box connectors and from the lead terminals with a neutral solvent, such as Federal Specification P-S-661. Remove corrosion from pin sockets and terminals by wire brushing or lightly rubbing with fine emery cloth. Dry the connectors before further test and inspection to prevent short circuits.

4–203. INSPECTION.

a. Visually inspect terminals for damaged threads, bent pins, or cracked insulators. Repair bent pins or slightly damaged but usable threads. Replace cracked insulators or broken pins.

b. Visually inspect the junction box and cable wiring for worn or burned insulation, loose connections, or broken wires. Replace broken wires or wires with insulation burned, worn, or deteriorated. Loose connections should be tightened or resoldered.

c. Visually inspect the box and cover for cracked or peeling paint, loose locknuts, or loose jam nuts holding the AN connectors to the box. Check the cover fasteners for proper operation. Remove cracked or peeling paint and repaint the area. Locknuts or jam nuts should be tightened or replaced.

d. Visually inspect the cable, the box, and the AN connectors for corrosion. Remove corrosion from the threads and pins of connectors with a wire brush or fine emery cloth.

e. Visually inspect the cable conduit, chafing guards, wiring, and terminals. Inspect the braided shielding for broken strands, the chafing guard for tears or frays, the terminals for thread damage, bent pins, cracked insulators, and similar damage.

f. Visually inspect the decalcomania on the inside of the island junction box for tears, fading, looseness, mutilation, or similar damage.

4–204. REPAIR AND REPLACEMENT.

a. Remove the junction box cover and examine the wiring and Amphenols, as in previous paragraphs. Amphenols may be removed, replaced, or repaired in accordance with T.O. No. 8D4-1-31 Handbook Operation and Service Instructions, AN Electrical Connectors.

b. Unsolder wire which has worn, burned, or otherwise damaged insulation and replace it with an equal length of equal quality wire.

c. If Amphenols are removed for replacement or rework, they must be replaced with the index in the original position.

d. Unless one of the cable leads is to be repaired or replaced, disassembly is not recommended. Cable Amphenols may be removed, replaced, or repaired in accordance with T.O. No. 8D4-1-31, Handbook Operation and Service Instructions, AN Electrical Connectors.

e. When a portion of the rubber chafing guard is torn, cut, or frayed, it may be cut out and removed. Leads with the chafing guard completely or partially removed are still serviceable.

f. Hammer out dents, dimples, scores, scratches, or bends in the box or box cover or remove them with fine sandpaper or fine emery cloth. Repaint or retouch the box and cover with a good commercial black enamel.

g. Replace the wiring decalcomania on the inside of the cover if the decal is excessively worn, torn, faded, or soiled. Coating the decal with a good commercial varnish or shellac will help to preserve it.

4–205. LUBRICATION. No lubrication is required.

4–206. REASSEMBLY. Reassemble only with new or repaired parts as required by inspection.

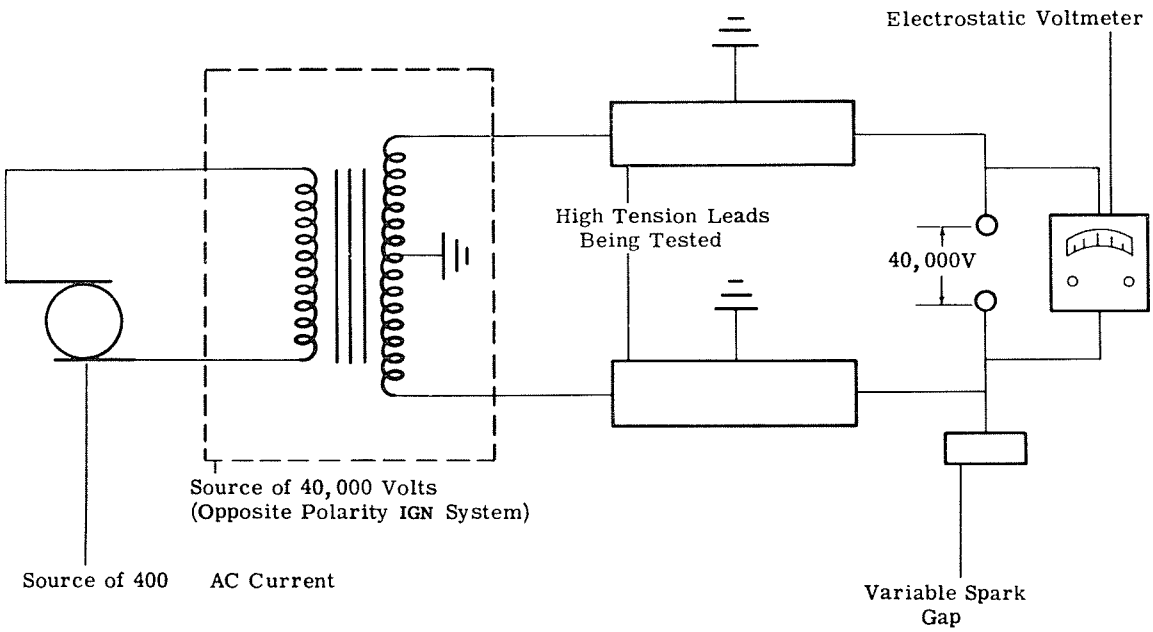
4–207. TEST PROCEDURE.

a. Test Equipment. To test the No. 1 island cable assembly, the following test equipment is required:

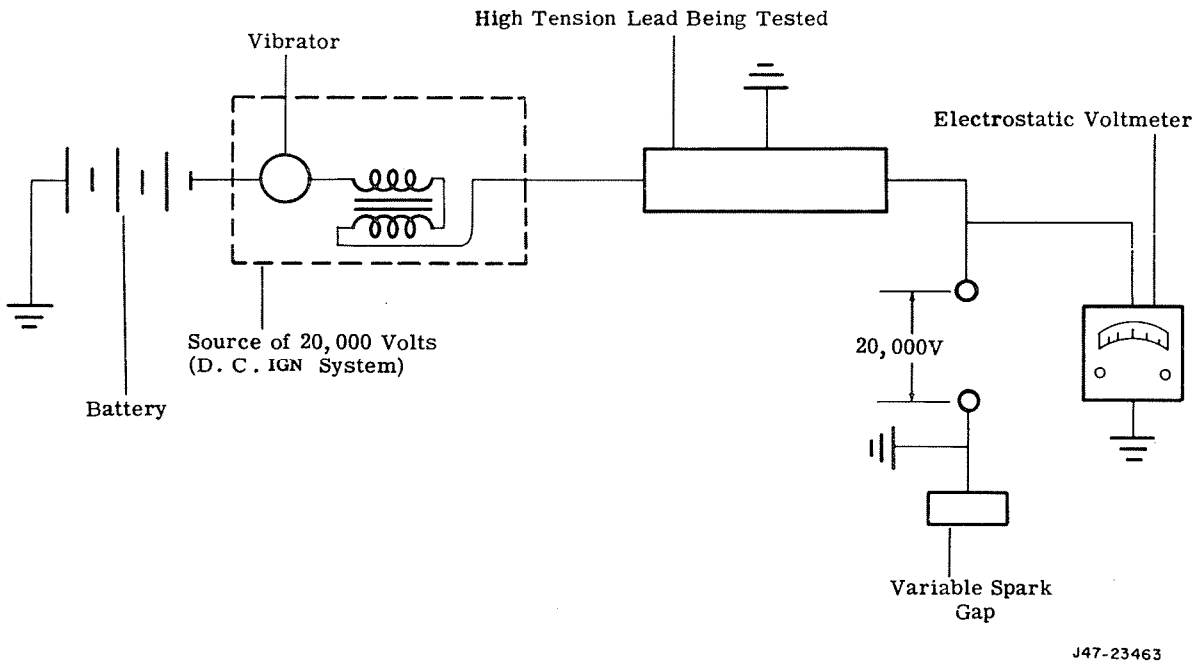
(1) A 500 volt megger.

(2) A Simpson meter, or other means to check continuity.

b. Resistance Test. Measure the resistance between each lead and all other leads, and between each lead and either the cable shield (ground) or the junction box case with 250 volts dc applied. The resistance shall not be less than 10 megohms.



A

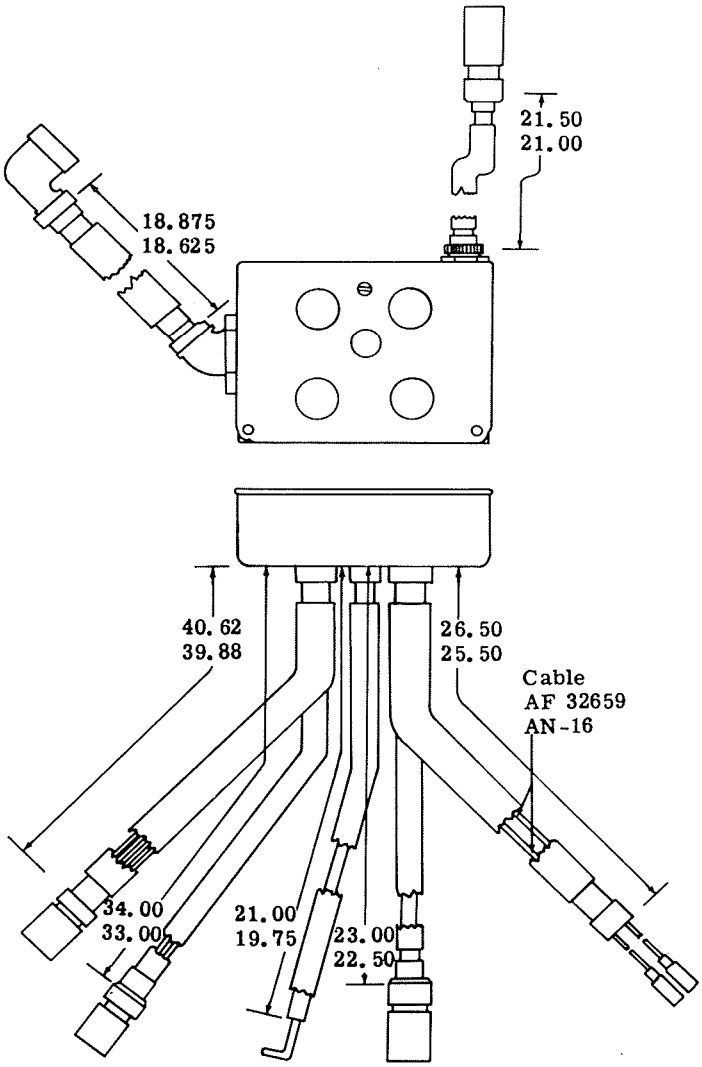
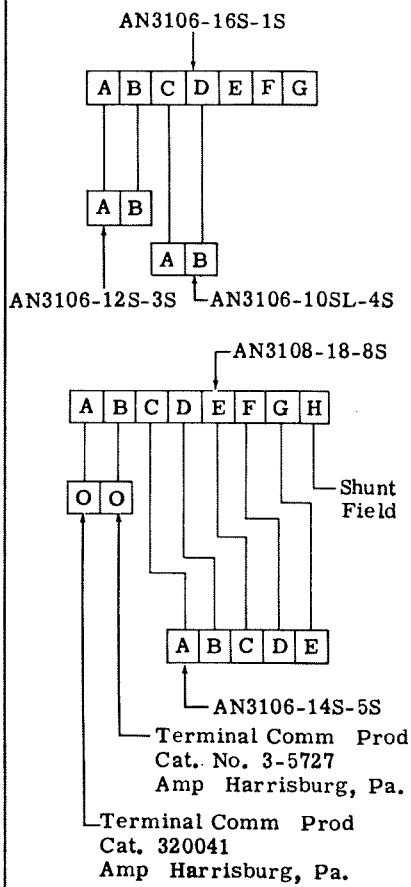


B

Figure 4-102. System Schematics for Testing High Tension Leads Without a Test Stand

TABLE XXIV. LEADING PARTICULARS OF NO. 1 ISLAND CABLES

Table of Leading Particulars

Spec Drwg Number	Lead Length	Wiring Diagram
508E403	 All Cables: MIL-W-5036 (Except as noted) Designation AN-16	
508E635	Same as Above	Same as Above

J47-23461

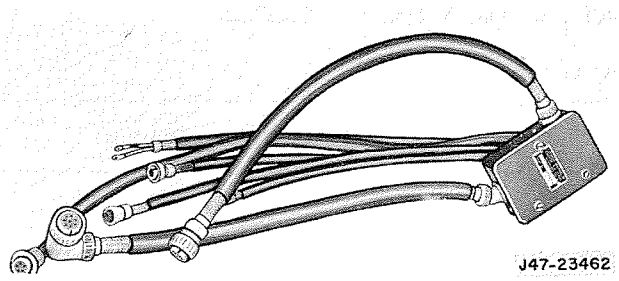


Figure 4–103. No. 1 Island Cable Assembly P/N 508E403

c. Continuity Test. Check the wiring of the cables and the junction box for continuity in accordance with the sketch in table XXIV. Use a Simpson Meter or other type of continuity checker.

Note

Electrical leads with the chafing guards severely damaged or removed are still serviceable. Do not use electrical tape to repair chafing guard.

4–208. STARTER-GENERATOR CABLE ASSEMBLY.

4–209. GENERAL. The starter-generator cable (figure 4–105) is used to conduct high amperage, low voltage d-c current to the starter-generator when the machine is used as a starter and from the starter-generator when the machine is used as a generator. The cable consists of three heavy leads which run from quick disconnect plugs fastened on the No. 1 island to the terminal board of the starter-generator. The following paragraphs contain minor repair instructions for the starter-generator cable assemblies listed below.

Figure 4–104. Deleted

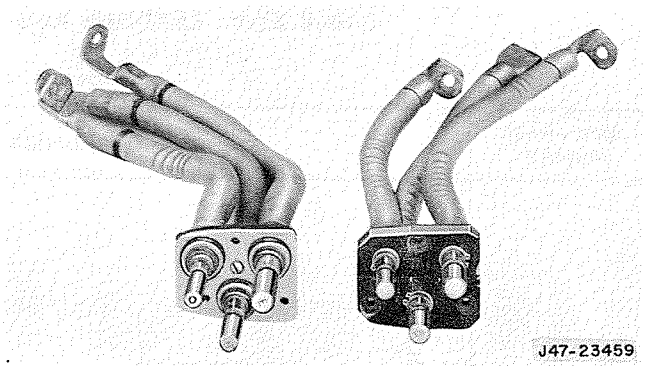


Figure 4–105. Starter Generator Cable Assembly P/N 126C459

Spec Dwg.	Model No.	Supplier
126C459	11128	Airtron, Inc
126C459	6476	Co-operative Industries

4–210. LEADING PARTICULARS. Leading particulars of the starter-generator cable assembly are shown in table XXV.

4–211. SPECIAL TOOLS. No special tools are required to disassemble or assemble the starter-generator cable.

4–212. DISASSEMBLY.

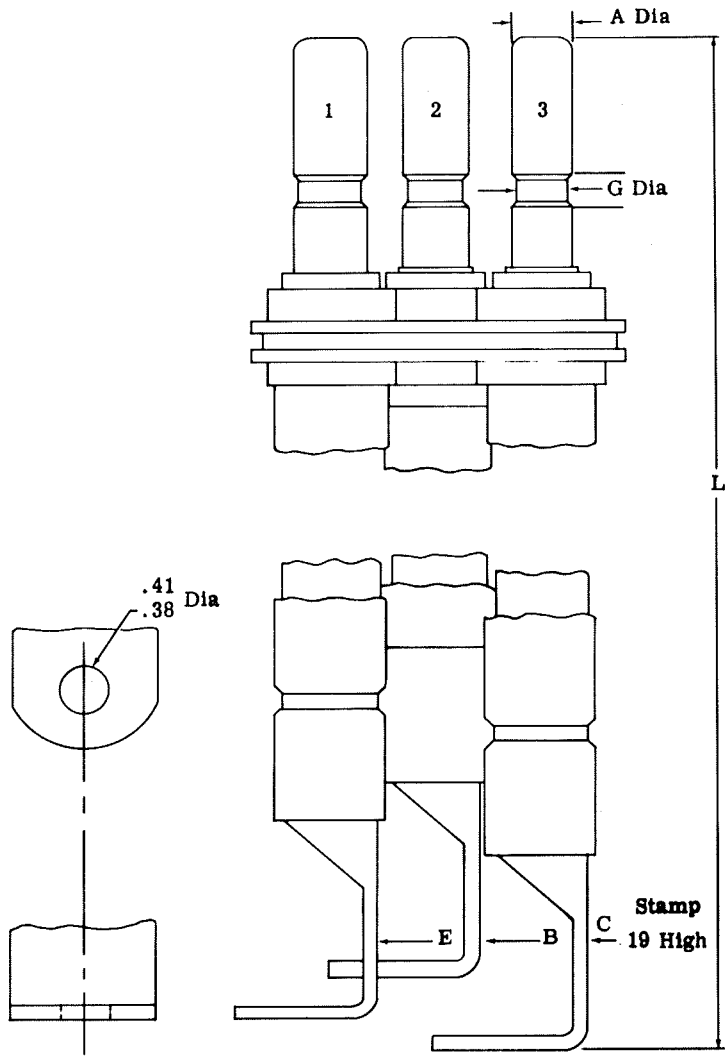
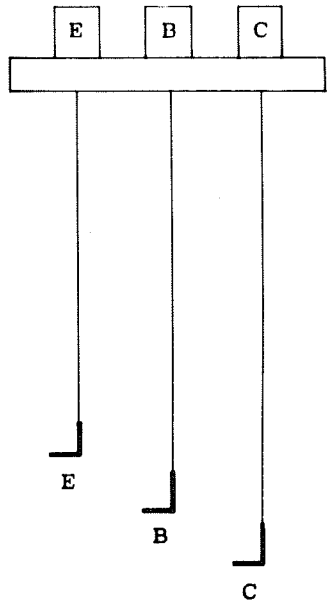
a. Individual leads may be removed from the insulator block by removing the retaining snap ring or nut.

b. Terminals may be removed and replaced by equal parts in accordance with standard shop practice.

4–213. CLEANING. Grease and oil must be removed from the quick-disconnect terminals and from terminals marked B, C, and E, (table XXV). Remove corrosion from the terminals by wire brushing or lightly rubbing the terminals with fine emery cloth. Remove all loose particles with a soft brush.

TABLE XXV. LEADING PARTICULARS OF THE STARTER-GENERATOR CABLE ASSEMBLY

Table of Leading Particulars

Spec Drwg Number		Wiring Diagram
126C495		

Cable	1	2	3
A Dia	.5620 .5600	.4995 .4975	.4370 .4350
G Dia	.500 .495	.437 .432	.374 .369
L	20.50 20.00	18.75 18.25	16.75 16.25

J47-23458

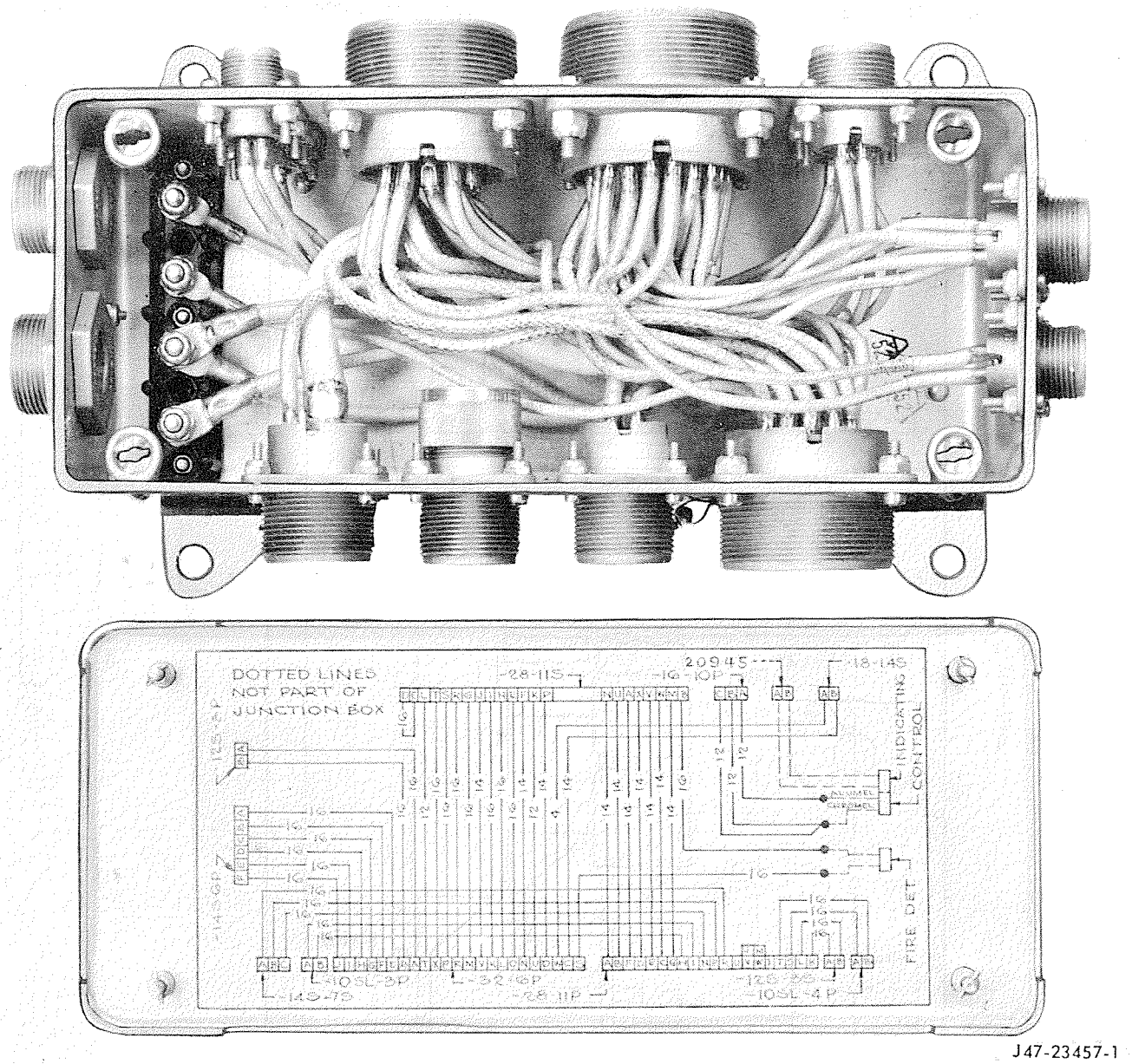


Figure 4–106. Junction Box Assembly, Spec. No. 122D143

4–214. INSPECTION.

a. Visually inspect the lead insulation for wear or deterioration.

b. Be sure that the terminals are securely attached to the heavy copper leads.

c. Inspect the rubber or vinyl insulation for worn spots, splits, frays, or other defects.

d. Test the attachment of each terminal with a pull of 25 pounds.

4–215. REPAIR AND REPLACEMENT. Repair the starter-generator cable and replace parts in accordance with standard practice.

4–216. TEST PROCEDURE. No test is required on the starter-generator cable. If marked terminals are replaced, be sure that a correctly marked terminal is reinstalled.

4–217. JUNCTION BOX ASSEMBLIES.

4–218. GENERAL. Junction boxes (figures 4–106 and 4–107) are used to accumulate electrical wiring at single accessible points. At these points air-frame wiring is connected to the junction box, thus providing power to operate ignition systems, solenoid valves, screen retraction systems, etc. Thermocouple signals, tachometer signals, fire detection signals are examples

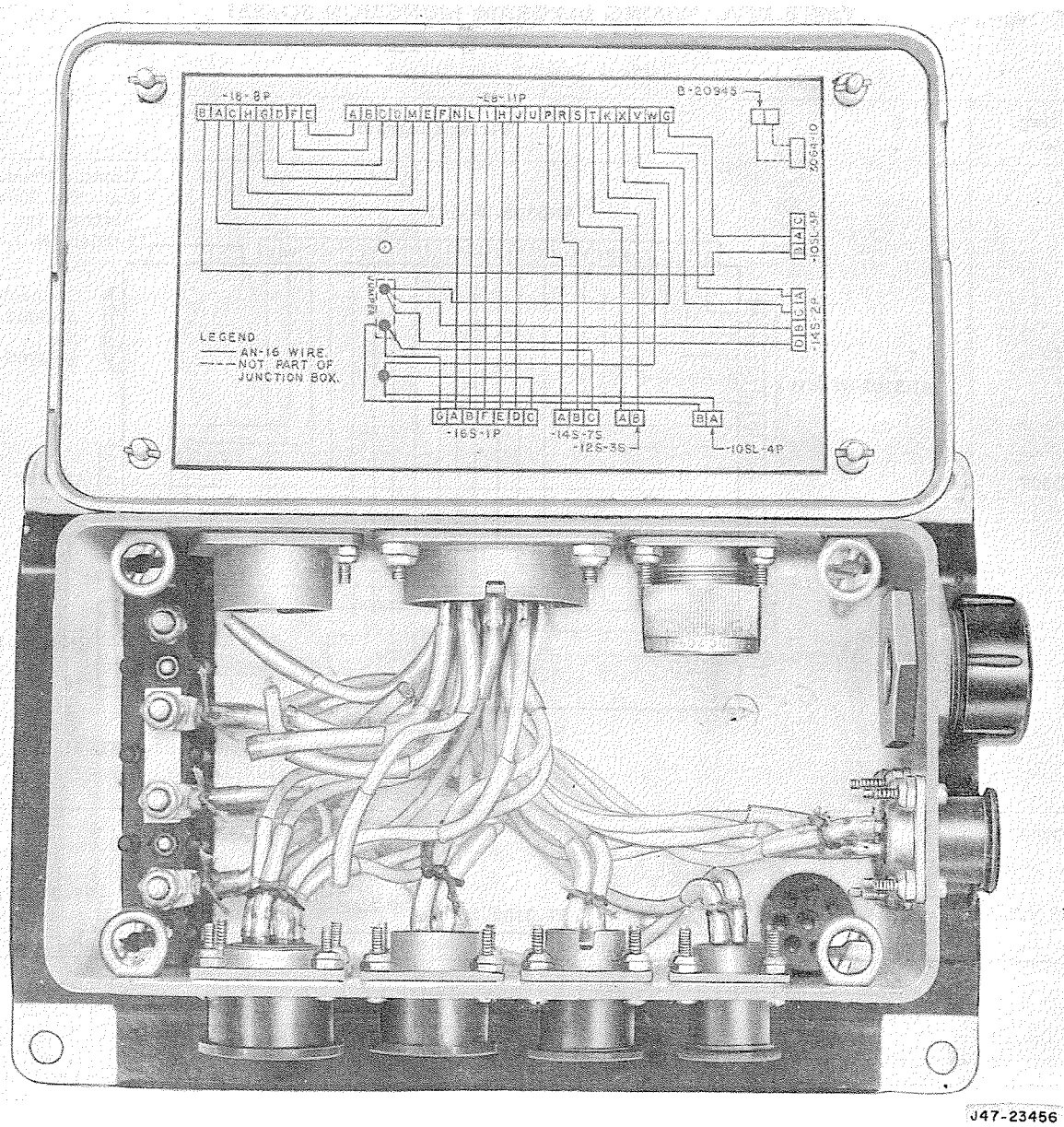


Figure 4–107. Junction Box Assembly, Spec. No. 124D507

of the type of information relayed to cockpit indicators through the junction box. The following paragraphs contain minor repair instructions for the junction box assemblies.

4–219. LEADING PARTICULARS. Leading particulars of the junction boxes are shown in table XXVI.

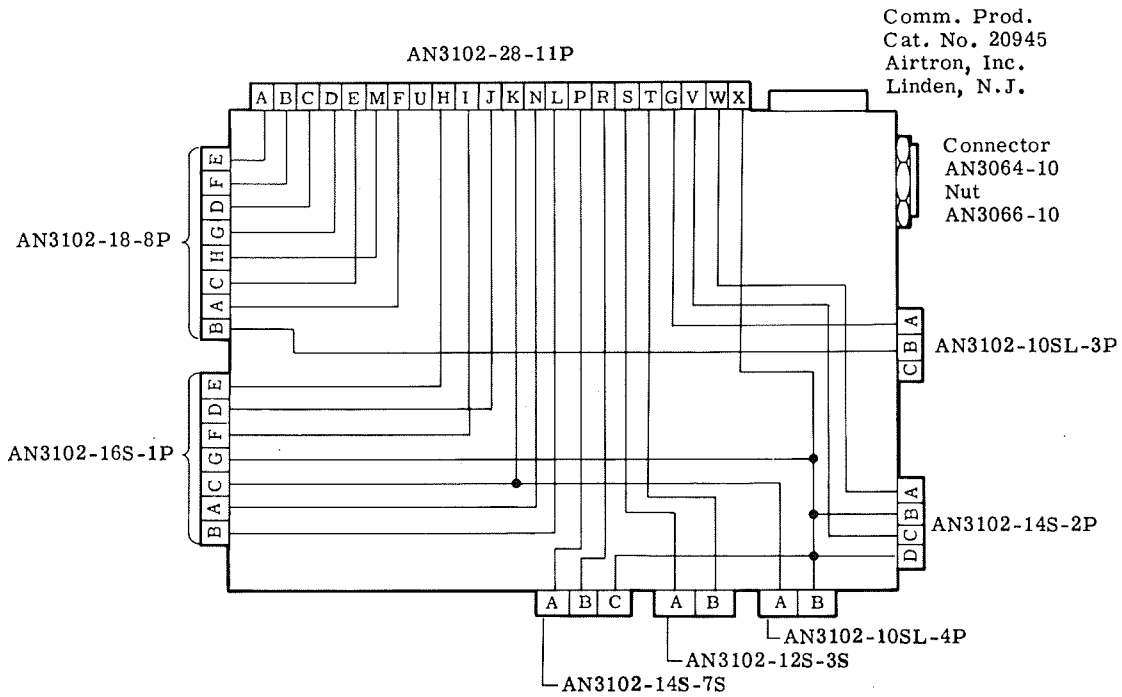
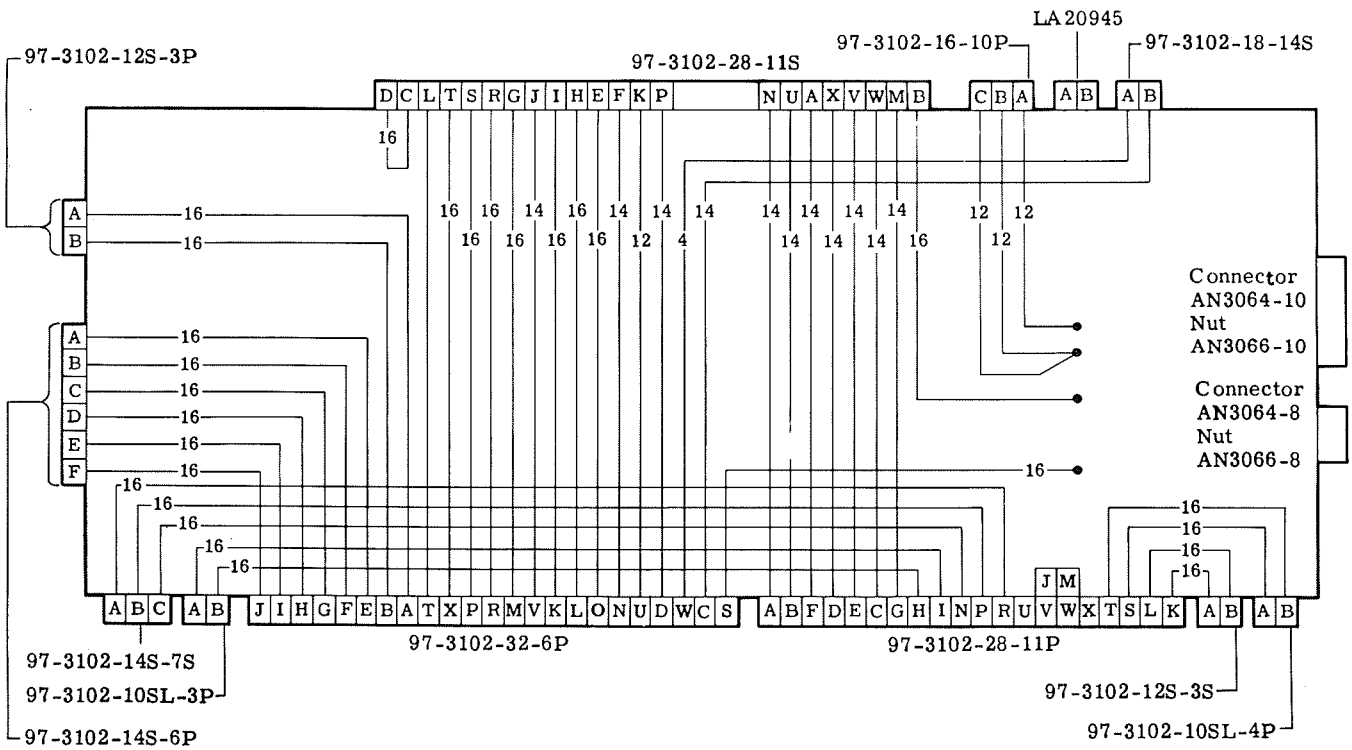
4–220. SPECIAL TOOLS. No special tools are required to disassemble or assemble the junction boxes.

4–221. DISASSEMBLY. Aside from removing the cover, no disassembly is recommended unless leads or receptacles need replacing. Pin-type connectors may be removed, repaired, or replaced in accordance with T.O. 1–1A–14, Section III.

Spec Dwg.	Model No.	Supplier
124D507	11132	Airtron, Inc.
124D507	M7202	Monowatt Corp
124D507	6820	Co-operative Industries
122D143	5294660	Packard Electric Div, GMC
122D143	M7203	Monowatt Corp
122D143	6285	Co-operative Industries
122D143	11106	Airtron, Inc

TABLE XXVI. WIRING DIAGRAM (JUNCTION BOXES)

Table of Leading Particulars

Spec Dwg. Number	Wiring Diagram
124D507	
122D143	

4-222. CLEANING.

a. Grease and oil must be removed from the receptacles with a suitable neutral solvent, such as Federal Specification P-S-661.

Note

Dry receptacles before further testing and inspection to prevent flashover.

b. Clean the junction box by blowing out the box with dry, compressed air.

CAUTION

Avoid the use of cleaning solvents or liquids around electrical insulation, since use of some types of solvents may cause damage to the assembly.

4-223. INSPECTION.

a. Visually inspect terminals for damaged threads, bent pins, or cracked insulators. Repair bent pins or slightly damaged but usable threads. Replace cracked insulators or broken pins.

b. Visually inspect junction box wiring for worn or burned insulation, loose connections, or broken wires. Replace broken wires or wires which have insulation burned, worn, or deteriorated. Loose connections should be tightened or resoldered.

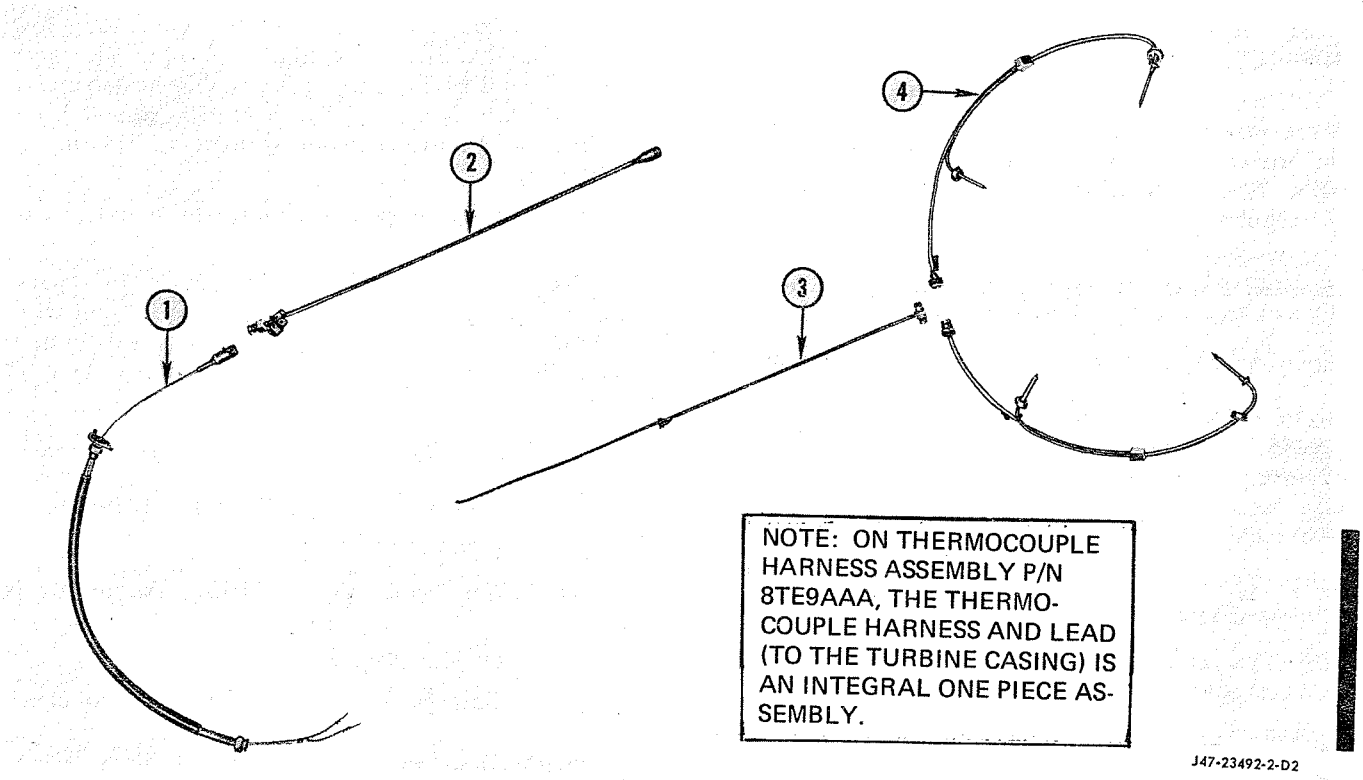
c. Visually inspect the box and cover for cracked or peeling paint, loose locknuts or loose jam nuts holding the AN connectors to the box. Check the cover fasteners for proper operation. Remove cracked or peeling paint and repaint the area. Locknuts or jam nuts should be tightened or replaced.

d. Visually inspect the decalcomania on the inside of the cover for tears, fading, looseness, and mutilation.

e. Visually inspect AN connectors, the box, and the cover for corrosion. Remove corrosion from the threads and pins of connectors with a wire brush or fine emery cloth.

4-224. REPAIR AND REPLACEMENT.

a. Remove the junction box cover and examine the wiring and AN connectors as outlined in previous paragraphs. AN connectors may be removed, repaired, or replaced in accordance with T.O. 1-1A-14, Section III.


1
2
3
4
NOTE: ON THERMOCOUPLE HARNESS ASSEMBLY P/N 8TE9AAA, THE THERMOCOUPLE HARNESS AND LEAD (TO THE TURBINE CASING) IS AN INTEGRAL ONE PIECE ASSEMBLY.
J47-23492-2-D2

1. Junction Box to Firewall
2. Firewall to Turbine Casing
3. Turbine Casing to Tailpipe
4. Thermocouple Harness

Figure 4-108. Thermocouple System Components

b. Unsolder wire which has worn, burned, or otherwise damaged insulation and replace with an equal length of equal quality wire. For junction box 124D507, all wire is MIL–W–5086, and cable designation is AN16. For junction box 122D143, all wire is MIL–W–5086, and cable designation is as shown in table XXVI.

c. If Amphenols are removed for replacement or rework, they must be replaced with the index in the original position.

d. Hammer out dents, dimples, scores, scratches, or bends, in the box or box cover or remove them with sand paper or emery cloth. Repaint or retouch the box or box covers with a good commercial black enamel.

e. Replace the wiring decalcomania on the inside of the cover if the decal is excessively worn, torn, faded, or soiled. Coating the decal with a good commercial varnish or shellac will help to preserve it.

4–225. LUBRICATION. No lubrication is required.

4–226. REASSEMBLY. Aside from replacing the cover, no other reassembly is required unless leads or receptacles have been removed.

4–227. TEST PROCEDURE.

a. Test equipment. The following equipment is required:

(1) A 500 volt megger.

(2) A Simpson Meter or other means to check continuity.

b. Insulation Resistance. Measure the resistance between each lead and all others, and between each lead and the case using a dc voltage between 250 and 500 volts. The measured resistance shall not be less than 10 megohms.

c. Continuity Test. Check cables for continuity in accordance with the wiring diagram shown in table XXVI. Use a Simpson Meter or similar device.

4–228. THERMOCOUPLE SYSTEM COMPONENTS.

4–229. GENERAL. The tailpipe thermocouple system provides the pilot with an indication of the tailpipe operating temperature. The following paragraphs contain minor repair information for the following thermocouple system components. (See figure 4–108.)

4–230. LEADING PARTICULARS. Leading particulars are shown in table XXVII.

4–231. SPECIAL TOOLS. No special tools are required to disassemble or assemble the leads or harnesses.

4–232. DISASSEMBLY. Disassembly is not required.

4–233. CLEANING. Thoroughly clean all pins and sockets, using clean cloth and pipe cleaners dampened with solvent Federal Specification TT–M–261. Use this solvent and a brush to clean all thermocouple components.

CAUTION

Do not use wire brush or other abrasives on pins, sockets or junctions. Pins and sockets are platinum plated to protect contacts from oxidation.

4–234. INSPECTION. Visually inspect lead terminals for damage to threads, bent pins or cracked insulators. Replace cracked insulators or broken pins.

Spec Dwg.	Model No.	Nomenclature
124D749-5	9888683G5	Thermocouple, Tailpipe Harness
326C182-1	9890480G1	Lead, Turbine Casing to Firewall
124D757	9888681G1	Lead, Firewall to Junction Box
326C182-2	9890480G2	Lead, Turbine Casing to Firewall
326C183-2	9890473G2	Lead, Tailpipe to Turbine Casing
– – –	8TE9AAA	Harness Assembly, Tailpipe

4–235. REPAIR OR REPLACEMENT.

a. Thermocouple harness assemblies which show low pin-to-ground resistance or high pin-to-pin resistance readings, shall be installed in a suitable heat treating oven (no open flame) and baked at 350° to 500°F for one hour to remove moisture content within the assemblies.

b. Remove the assemblies from the oven and cool to room temperature.

c. Recheck each assembly for resistance in accordance with paragraph 4–238, "c"; (1) and (2) and table XXVII. Assemblies within these limits are serviceable. Assemblies which do not meet these limits shall be replaced.

4–236. LUBRICATION. No lubrication is required.

4–237. REASSEMBLY. No reassembly is required.

4–238. TEST PROCEDURE.

a. Test Equipment. The following equipment is needed:

(1) A 500 volt megger.

(2) A Simpson Meter (or equivalent) to check continuity.

b. Hi-Potential Test. (For 124D757 only.) Apply 500 volts dc between leads and sheath for 30 seconds. There should be no evidence of breakdown.

c. Insulation Resistance.

(1) (For 124D757 only.) Use a 500 volt dc megger

to test insulation resistance between leads and from each lead to the conduit. Insulation resistance must not be less than 1000 ohms. During this test, flex the braided conduit to determine if any broken strands have pierced the insulation and are shorting the lead.

(2) (For 8TE9AAA, 124D749, 326C182 and 326C183) use an ohmmeter to test insulation resistance between connector jack and sheath on 124D749 and 8TE9AAA, and between each connector jack and sheath and between jacks on 326C182 and 326C183. Insulation resistance must not be less than 1000 ohms.

d. Circuit Resistance. Short the wires in one end of each lead assembly together and measure the circuit resistance from the other end. (On 124D749 no shorting is necessary.) Circuit resistance must be within the limits in table XXVII.

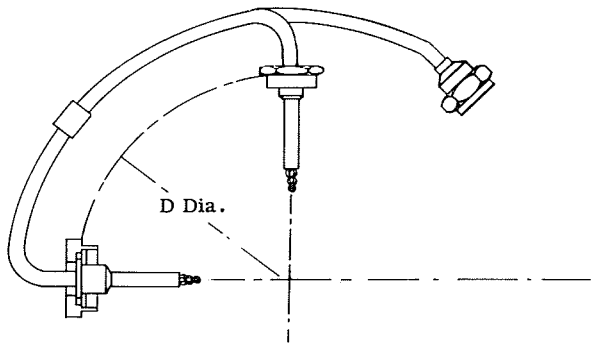
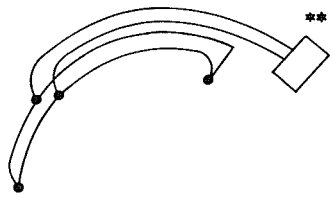
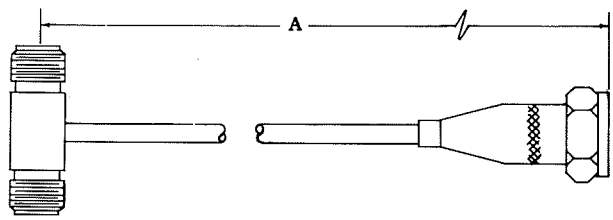
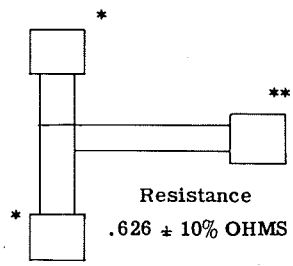
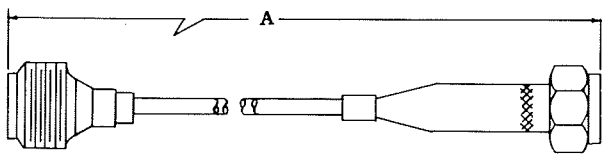
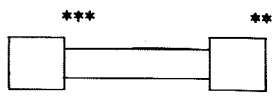
e. Continuity.

(1) Check all leads for continuity when performing the circuit resistance test.

(2) Check lead 124D749 for continuity by connecting the positive side of a millivolt meter to the chromel pin and negative side to the alumel pin. Apply heat to each thermocouple junction in turn. A positive deflection of the meter indicates correct polarity and continuity for that portion of the circuit.

TABLE XXVII. LEADING PARTICULARS OF THERMOCOUPLE SYSTEM

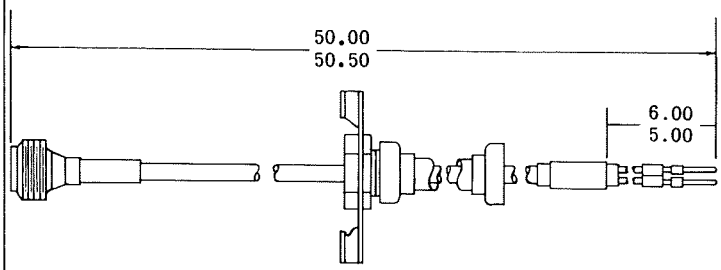
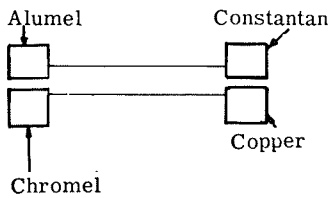
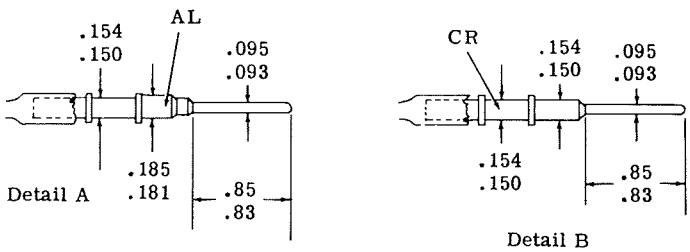
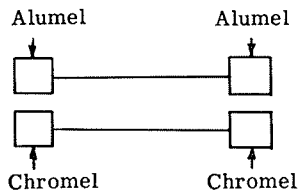
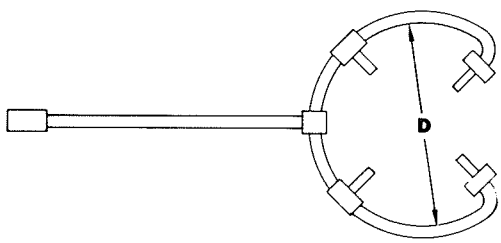
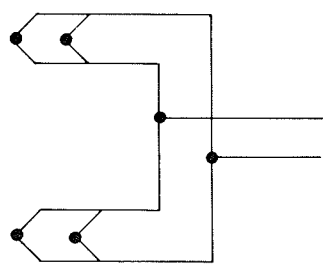
Table of Leading Particulars

Spec. Dwg. Number	Lead Length	Wiring Diagram
124D749-1	 D Dia. 22.06-22.13	 Resistance .587-.717 OHMS
124D749-3	Same as Above D-Dia. 21.7-21.8	Same as Above Resistance .582-.710 OHMS
326C183-1	 A - 66.00-66.25	 Resistance .626 ± 10% OHMS
326C183-2	Same as Above A - 72.00 - 72.25	Same as Above Resistance .683 ± 10% OHMS
326C182-1	 A 34.12 - 34.38	 Resistance .313 ± 10% OHMS
326C182-2	Same as Above A = 27.00 - 27.25	Same as Above Resistance .247 ± 10% OHMS

J47-23490

TABLE XXVII. LEADING PARTICULARS OF THERMOCOUPLE SYSTEM (cont.)

Table of Leading Particulars

Spec. Drwg. No.	Lead Length	Wiring Diagram
		 124D764
		 124D763
8TE9AAA	 NOTE D Diameter is variable since harness is semi-flexible	 J47-23491-2-A2

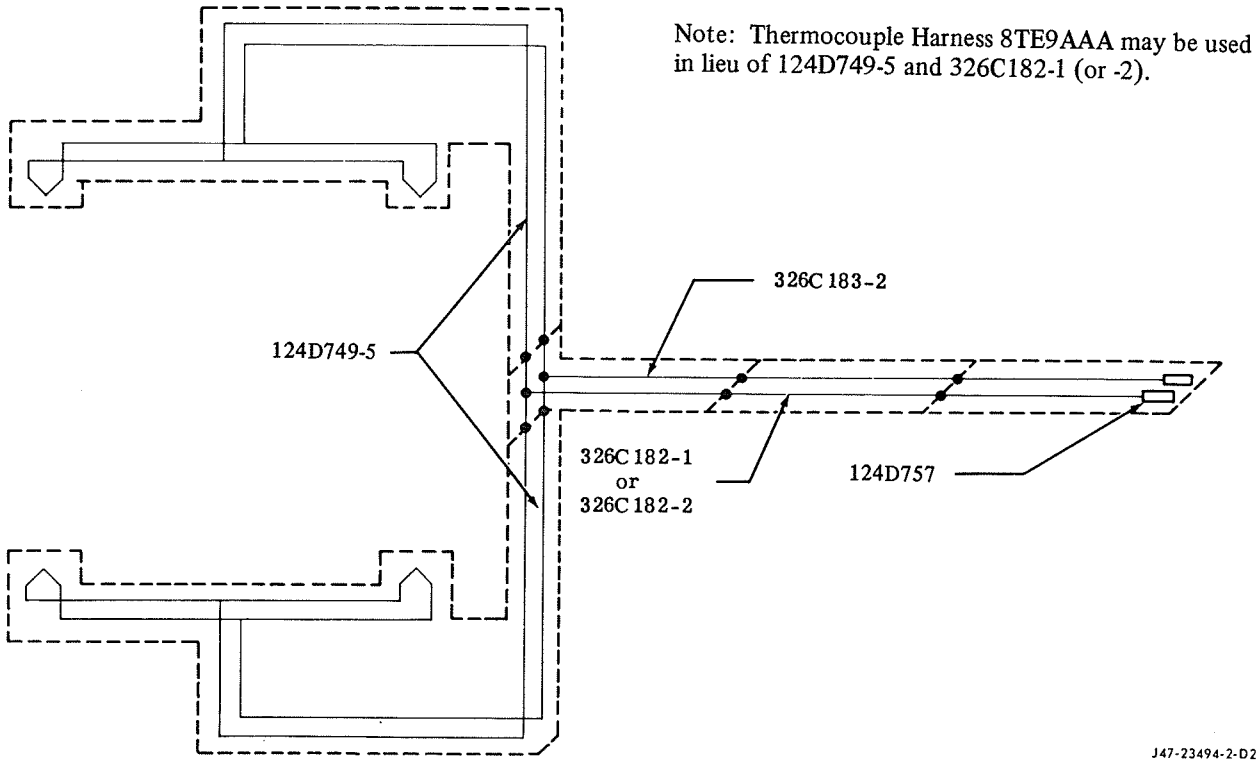


Figure 4–109. Thermocouple System Wiring

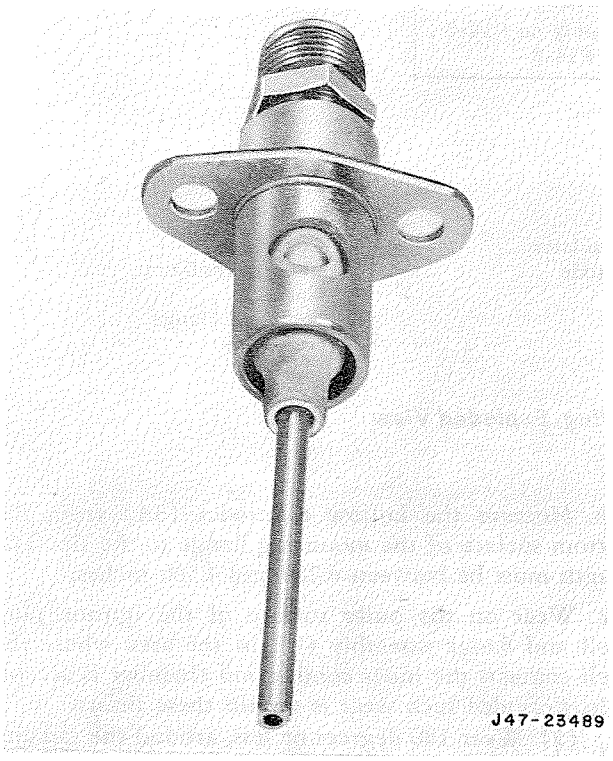


Figure 4–110. Ignitor Plug, Part No. 9482069

(3) Connect the leads as shown in figure 4–109 and apply heat as explained in step "b". Check the continuity and polarity of a thermocouple system.

4–239. IGNITOR PLUGS.

4–240. GENERAL. Four ignitor plugs (figure 4–110) are used on the J47 engines to ignite the fuel-air mixture in the combustion chambers. Two single-electrode ignitor plugs are installed in each of the combustion chambers, No. 3 and 7. The following paragraphs contain minor repair instructions for the ignitor plugs listed below.

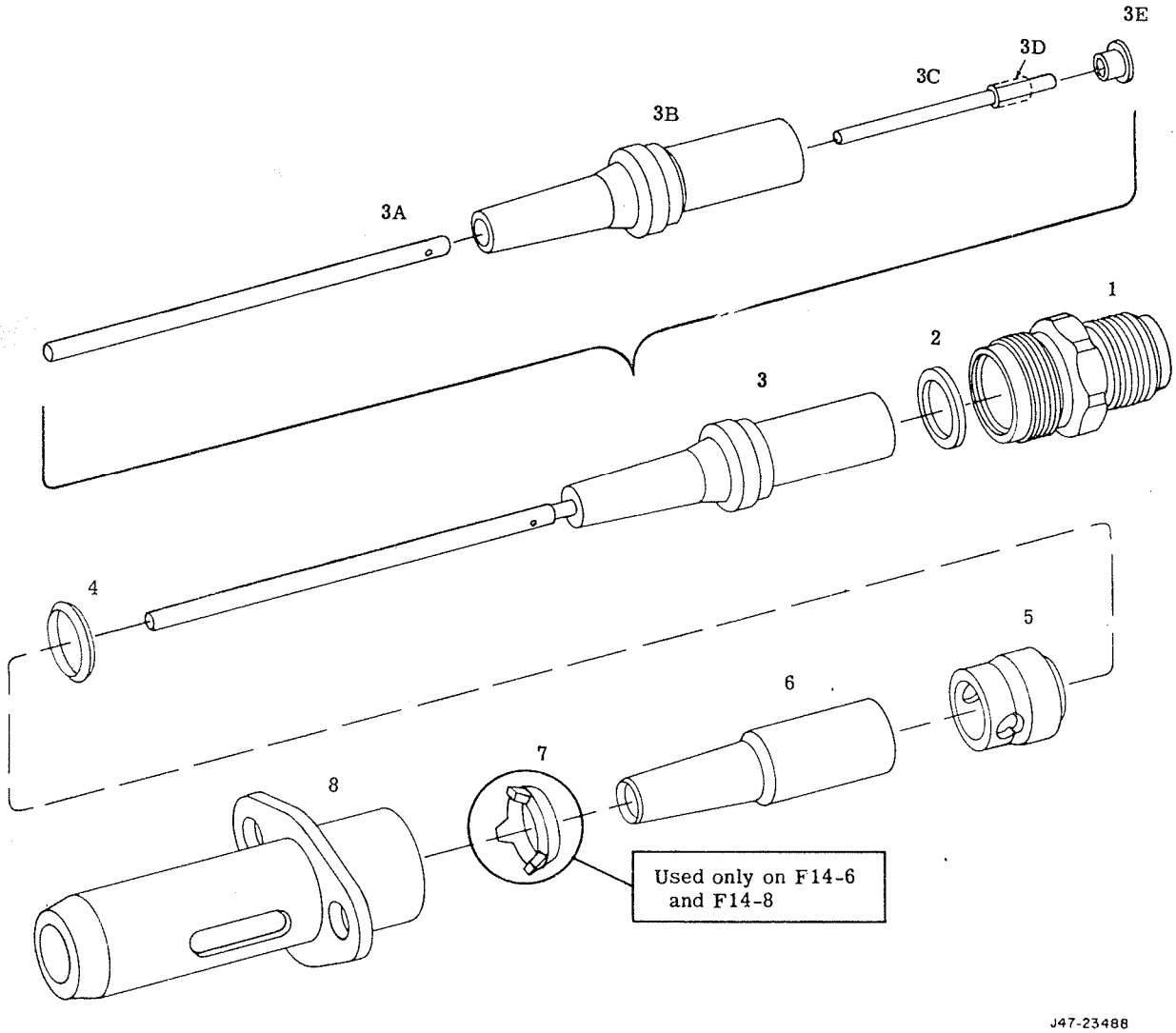
Spec Dwg.	Model No.	Supplier
9482069	F–14–6	Champion Spark Plug Co
9482069	F–14–8	Champion Spark Plug Co
9482069	F–14–19	Champion Spark Plug Co
9482069	B–10355	B. G. Corp
9482069	A–7746	B. G. Corp

4–241. LEADING PARTICULARS.

a. Electrode Length .....4.280–4.360 inches (measured to bottom of mounting flange)

b. Flatness of Mounting Flange..Within 0.015 inch

4–242. SPECIAL TOOLS. No special tools are required.



1. Bushing
2. Gasket
3. Insulator, Electrode and Terminal Assembly
3A. Hollow Electrode
3B. Ceramic Insulator
3C. Solid Electrode
3D. Sillment
3E. Terminal
4. Gasket
5. Cone Seat
6. Ceramic Insulator
7. Gasket
8. Shell and Flange Assembly

Figure 4–111. Typical Igniter Plug, Exploded View

4–243. DISASSEMBLY. No disassembly is required.

4–244. CLEANING.

a. Use a soft bristle brush dipped in cleaning solvent, Federal Specification P–S–661, to clean oil and grease from the threads and exposed parts of the plug. Dry the plug with compressed air.

b. Use a blast-cleaning machine to clean the ignitor plug. Remove the plug, wash thoroughly in the cleaning solvent, and dry with compressed air.

4–245. INSPECTION. (See figure 4–111.)

a. If the porcelain is cracked or broken, or the electrodes are pitted or eroded, replace the plugs.

b. Measure the hollow electrodes (3A) from the bottom surface of the mounting flange to the tip. The length must be between 4.280 and 4.360 inches.

c. Wear on the outer surface of the ignitor plug shell and flange assembly (8), in the area where the shell contacts the inner combustion chamber is acceptable, provided such wear is within these limits:

(1) Wear 180 degrees or less, around the circumference and not over 0.015 inch deep.

(2) Wear between 180 degrees and 270 degrees around the circumference and not over 0.0075 inch deep.

(3) Wear between 270 degrees and 360 degrees around the circumference and not over 0.005 inch deep.

d. Any crack in the shell is cause for rejection.

e. Discoloration on the edge of the shell is acceptable but any loss or flaking of metal is cause for rejection.

f. Burning of the electrode must be limited to a depth of 0.010 inch and must not exceed 1/8 of the circumference.

4-246. REPAIR OR REPLACEMENT. Plugs are replaced as units. There is no component repair or replacement required.

4-247. LUBRICATION. No lubrication is required.

4-248. REASSEMBLY. None required.

4-249. TEST PROCEDURE. Test ignitor plugs functionally on engine.

4-250. FLUID INJECTION SYSTEM.

4-251. The fluid injection system on the J47 engines consists of the water-alcohol injection components. Minor repair instructions are given herein for the water-alcohol nozzles and fluid pressure switch.

4-252. FLUID INJECTION NOZZLES.

4-253. GENERAL. Thirty-two fluid injection nozzles (figure 4-112) are used on J47-GE-25 and -25A model engines to spray fuel into the 8 combustion chambers. The following paragraphs contain minor repair instructions for the models of the fluid injection nozzles listed below.

Spec Dwg.	Model No.	Supplier
414B494	S-2680	W. F. Steinen Co
414B494	1388	Spray Engineering Co

4-254. SPECIAL TOOLS. No special tools are required for these items.

4-255. DISASSEMBLY. Do not disassemble the fluid injection nozzles.

4-256. CLEANING. Wash with a suitable carbon cleaning solution, followed by water and/or a suitable liquid petroleum. Dry with compressed air blast.

4-257. INSPECTION. Inspect for nicks, burrs, or other damage to the threaded area and the orifice area.

4-258. REPAIR AND REPLACEMENT.

a. Replace the nozzle if nicked or burred in the orifice area.

b. Repair minor thread damage with a fine file.

4-259. TEST PROCEDURE.

a. Test the nozzles functionally on the engine.

4-260. FLUID PRESSURE SWITCH.

4-261. GENERAL. The fluid pressure switch senses water alcohol pump discharge pressure and prevents overspeeding of the pump when the fluid is gone. Switch closes on increasing and opens on decreasing pressures at a setting of 220±10 psi (gage). The following sections contain minor repair instructions for Fluid Pressure Switch, Specification Drawing No. 131B407, Model YMS-220.

4-262. SPECIAL TOOLS. None required for this assembly.

4-263. DISASSEMBLY. Do not disassemble the fluid pressure switch.

4-264. CLEANING.

a. Remove grease and oil from the end connector with a neutral solvent, such as Federal Specification P-S-661.

b. Clean electrical connector pins with a fine abrasive paper or cloth. Remove all loose particles with a soft brush.

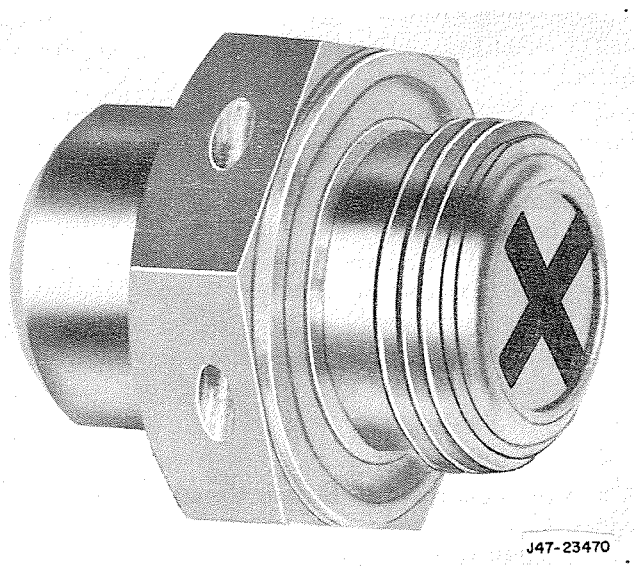


Figure 4-112. Fluid Injection Nozzle

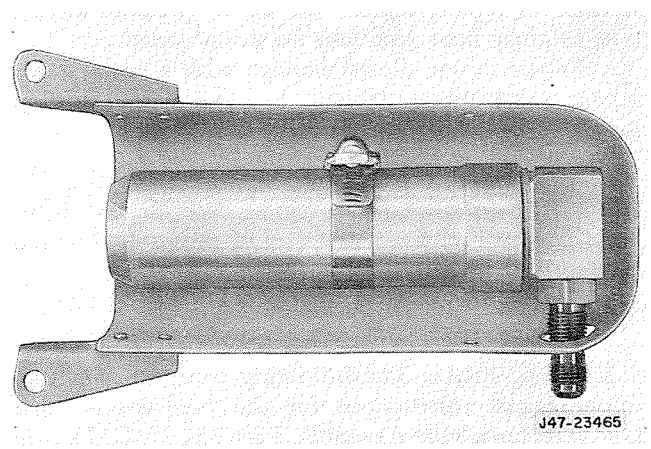


Figure 4-113. Cowl Guide Accumulator Assembly

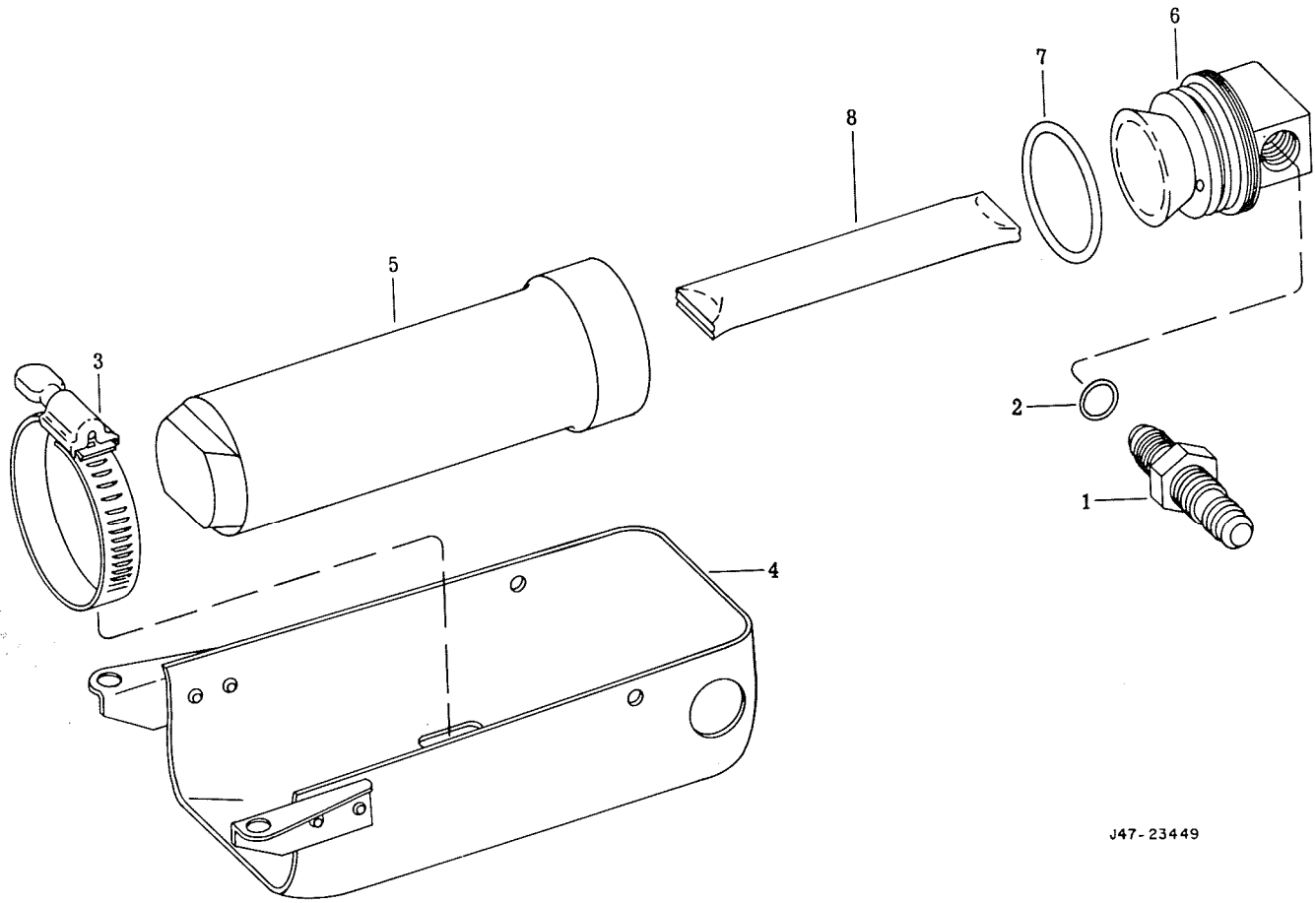


Figure 4–114. Exploded View, Cowl Guide Accumulator Assembly

Note

Dry the electrical connector carefully to prevent short circuits.

4–265. REPAIR AND REPLACEMENT.

a. If pressure switch fails in operation, do not attempt to repair, replace the entire pressure switch.

b. Slightly bent pins may be straightened.

c. Repair minor thread damage with a fine file.

4–266. TEST PROCEDURE. Test the pressure switch functionally in the aircraft.

4–267. FUEL SYSTEM.

4–268. The following paragraphs describe the minor repair procedures for a number of minor fuel system accessories.

4–269. COWL GUIDE ACCUMULATOR ASSEMBLY.

4–270. GENERAL. The following paragraphs contain minor repair instructions for the fuel system Cowl Guide Accumulator Assembly, Part No. 303D126, (figure 4–113). The purpose of the accumulator is to absorb and dampen fuel system oscillations.

4–271. LEADING PARTICULARS.

Capacity at 60 psi (gage) . . . . . 40 cc minimum
Operating Pressure . . 200 psi (gage) maximum

4–272. SPECIAL TOOLS. No special tools are required.

4–273. DISASSEMBLY. Disassemble in sequence of index numbers on figure 4–114. Note the following points:

a. Remove union (1) from cylinder cap (6).

b. Loosen clamp (3) and slide cylinder (5) out of cowl guide (4). Remove cylinder cap (6) from cylinder (5) and remove air sacks (8).

4–274. CLEANING. Wash all parts except air sacks and "O" rings (2, 7) with cleaning solvent, Federal Specification P–S–661. Flush with jet fuel before replacing air sacks.

4–275. INSPECTION.

a. Visually inspect all threads for corrosion or damage.

b. The air sack material, including the sealed ends, must be free from cracks, crazing, fissures, pin holes, air bubbles, and discoloration.

4–276. REPAIR OR REPLACEMENT.

a. Replace rubber "O" rings and air sacks if necessary.

4–277. LUBRICATION.

a. Apply anti-seize compound, Specification MIL–C–5544, to all threads.

b. Immerse "O" rings in hydraulic fluid before reassembly.

4–278. REASSEMBLY.

a. Reassemble in reverse order of index numbers on figure 4–114.

b. Torque cap (6) to 250-350 lb in.

c. Torque union (1) to 100-125 lb in.

4–279. TEST PROCEDURE.

a. Test the accumulator assembly functionally on the engine. Check carefully for leakage after engine shut down.

4–280. CHECK AND RESTRICTOR VALVE ASSEMBLY.

4–281. GENERAL. The check and restrictor valve (figure 4–115) contains a check valve which prevents high pressure main fuel from by-passing through the emergency system, and a restrictor valve which causes a 30 psi drop in pressure to prevent the emergency system from over-riding the main system at altitude. The following paragraphs contain minor repair instructions for the check and restrictor valve assemblies listed below:

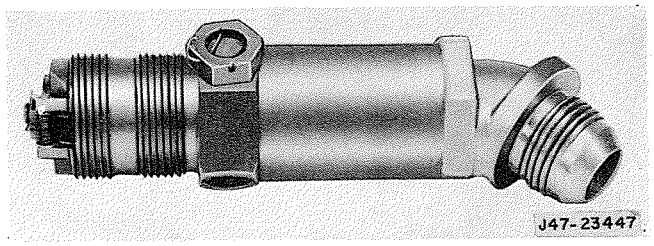


Figure 4–115. Check and Restrictor Valve Assembly

Spec Dwg.	Model No.	Supplier
326C537	1390–536897	Parker Aircraft
326C537	K1317–13	Kohler Company

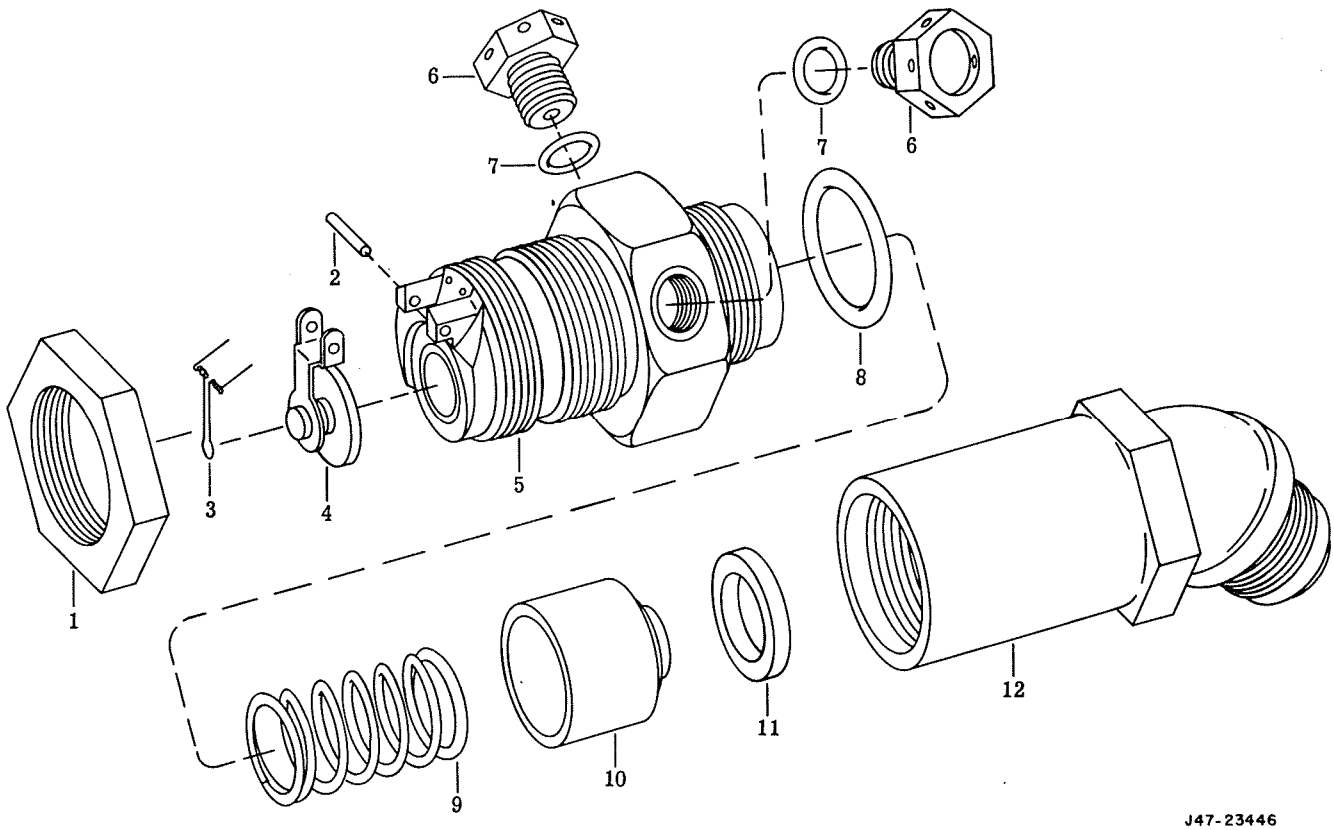


Figure 4–116. Check and Restrictor Valve Assembly, Exploded View

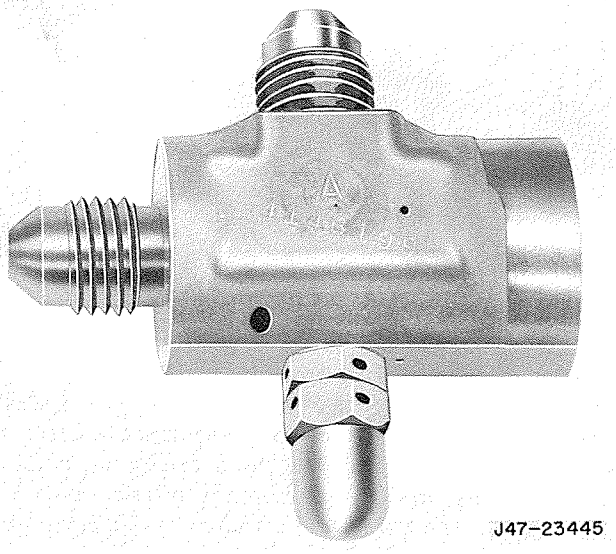
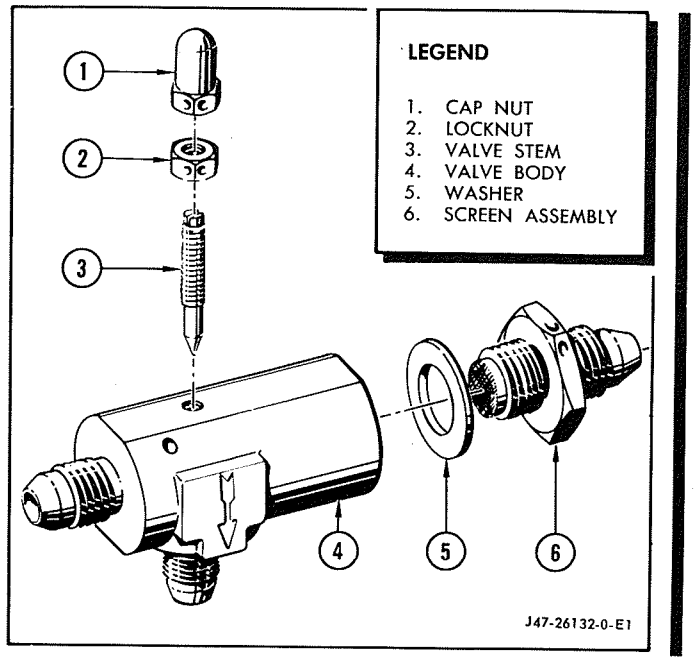


Figure 4–117. Compressor Discharge Pressure Bleed Valve



1. Cap Nut
2. Locknut
3. Valve Stem
4. Valve Body

Figure 4–118. Compressor Discharge Pressure Bleed Valve, Exploded View

4–282. SPECIAL TOOLS. No special tools are required to disassemble or assemble the valve.

4–283. DISASSEMBLY. Disassemble the valve in the order indicated by the index numbers on figure 4–116. Note the following points:

a. Unscrew cap (5) from valve body (12).

b. Remove spring (9) and cone (10) from body (12).

c. Do not remove cone seat (11).

Note

Do not disassemble the swing subassembly.

4–284. CLEANING. Wash all parts thoroughly with cleaning solvent, Federal Specification P–S–661, using a soft brush. Drain the parts after washing and dry with filtered compressed air.

4–285. INSPECTION. (See figure 4–116.)

a. Inspect seat for scratches, nicks, or other damage affecting sealing.

b. Inspect bosses on cap (5) for burrs, nicks, or other damage affecting free swing action of swing subassembly (4).

c. Check body (12) and cap (5) for cracks, deformation, or other structural damage. Check all threads.

4–286. REPAIR AND REPLACEMENT.

a. If internal parts are damaged in any manner, replace the entire valve assembly.

b. Repair minor thread damage with a fine file.

c. Replace "O" rings (7, 8) if necessary.

4–287. LUBRICATION. No lubrication is required.

4–288. REASSEMBLY. Reassemble the check and restrictor valve in the reverse of disassembly. See figure 4–116 and note:

a. Torque cap subassembly (5) to 150 lb in. and plugs (6) to 30 lb in.

b. Install new curing date decal if new "O" rings are installed.

4–289. TEST PROCEDURE. Test the Check and Restrictor Valve functionally on the engine; observe carefully for leakage after engine shut down.

4–290. VALVE ASSEMBLY-COMPRESSOR DISCHARGE PRESSURE BLEED.

4–291. IDENTIFICATION. The following sections contain minor repair instructions for Valve Assembly-Compressor Discharge Pressure Bleed P/N 414B199.

4–292. PURPOSE. One valve assembly is used on J47–GE–23, –25, and –25A model engines to reduce the tendency to stall in cold temperature (under 60°F) in altitudes under 10,000 feet, during ground run up and during rapid acceleration following a "wave-off".

4–293. LEADING PARTICULARS. Orifice size .073 ±.004 (No. 49 Drill).

4–294. SPECIAL TOOLS. No special tools are required to disassemble or assemble the valve.

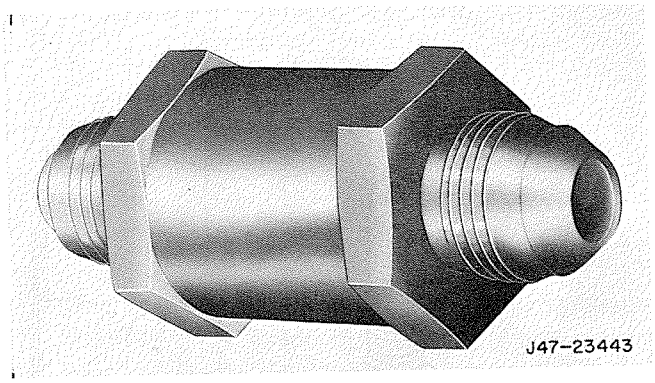


Figure 4-119. Check Valve

4-295. DISASSEMBLY. Remove lockwire, unscrew cap nut (1), loosen locknut (2), remove valve stem (3) and remove screen assembly (6).

4-296. CLEANING. Wash all parts thoroughly with cleaning solvent, Federal Specification P-S-661, using a soft brush. Particular attention will be directed to cleaning of screen assembly (Item 6, figure 4-118). Reverse airflow for drying will be used after washing as specified above. Drain the parts after washing and dry with filtered compressed air.

4-297. INSPECTION.

a. Visually examine all threads for scoring or cross-threading.

b. Inspect machined surfaces for burrs, nicks and scratches.

c. Inspect the valve and valve seat for wear or uneven seating. Seating surfaces of valve may be polished with a fine grade of emery crocus cloth.

d. Inspect screen assembly for thread damage; screen for cleanliness, tears or other damage.

4-298. TESTING. No component testing is required.

4-299. REPAIR AND REPLACEMENT. Little repair work is required on the parts of the valve. If parts become damaged or otherwise unserviceable, replace the entire assembly. Repair is limited to straightening threads, removal of nicks and burrs, and polishing valve.

4-300. LUBRICATION. No lubrication is required.

4-301. REASSEMBLY. Reassembly is the reverse of disassembly. Torque locknut to 25 in. lb and cap nut to 20 lb in.

4-302. TEST PROCEDURE. Test the CDP bleed valve functionally on the engine and check carefully for CDP air leakage.

4-303. CHECK VALVES (SWING TYPE).

4-304. GENERAL. The following paragraphs contain minor repair instructions for check valves, Model No. 3-350-81, Model No. K1332-6-2, Model No. 3-350-83, Model No. K1332-8, Model No. K1332-4-4 and Model No. 2625. (See figure 4-119.) The check valve allows fluid in a line to flow only in one direction.

4-305. SPECIAL TOOLS. No special tools are required for the check valve.

4-306. DISASSEMBLY. Disassemble in the order of index numbers shown in figure 4-120.

Note

Do not disassemble swing subassembly (4).

4-307. CLEANING. Wash parts with cleaning solvent, Federal Specification P-S-661. Dry with compressed air.

4-308. INSPECTION. (See figure 4-120.)

a. Examine rubber face of swing subassembly (4) for deterioration.

b. Examine spring (3) for breaks.

c. Examine pin (2) for proper seating and wear.

d. Examine threads for scoring or cross-threading.

e. Examine flare ends for scoring, dents, or nicks.

f. Move swing subassembly (4) back and forth to test for freedom of movement.

4-309. REPAIR AND REPLACEMENT. Replace the entire check valve if any of the internal parts are damaged.

4-310. LUBRICATION. None required.

4-311. REASSEMBLY.

a. Reassemble in the reverse order of index numbers shown on figure 4-120.

b. Torque body (6) to 40-50 lb in.

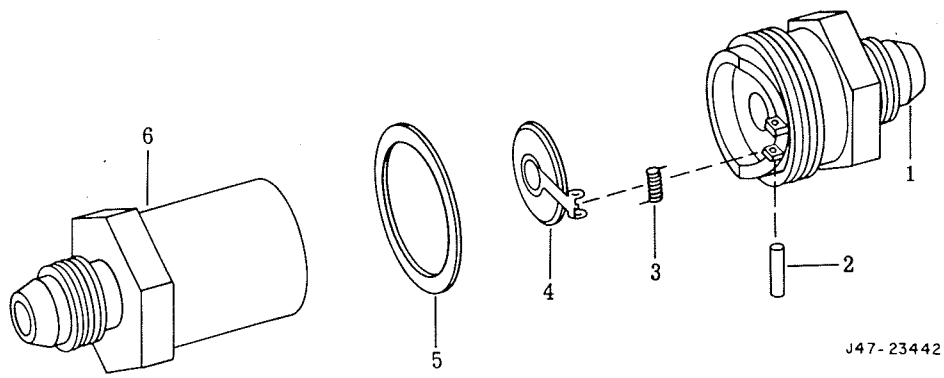


Figure 4-120. Check Valve, Exploded View

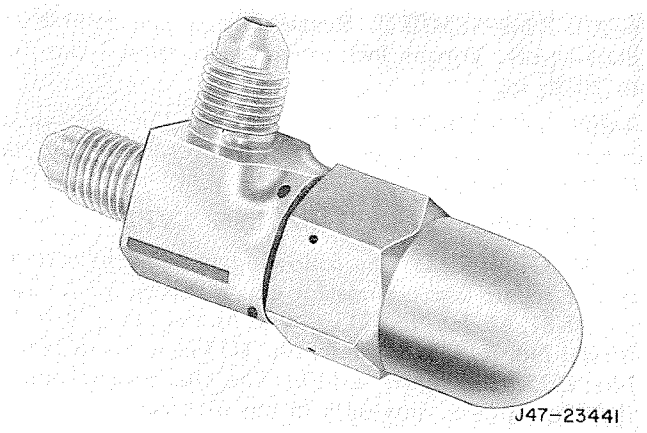


Figure 4–121. Fuel Regulator Valve Assembly

4–312. TEST PROCEDURE.

a. Test the check valve functionally on the engine, observe carefully for leakage.

4–313. FUEL REGULATOR VALVE ASSEMBLY.

4–314. GENERAL. The following paragraphs contain minor repair instructions for Fuel Regulator Valve Assembly, Part No. 326C338. (See figure 4–121.) There is an adjustable needle valve orifice between large and small slot manifolds in the fuel regulator valve which permits the adjustment of all J47 engines to a common acceleration time. The fuel regulator valve by-passes fuel from the small slot to the large slot manifold to accomplish this.

4–315. SPECIAL TOOLS. No special tools are required to assemble or disassemble the valve.

4–316. DISASSEMBLY. Disassemble in the sequence of index numbers shown in figure 4–122.

4–317. CLEANING. Wash all parts thoroughly with cleaning solvent, Federal Specification P–S–661, using a soft brush. Thoroughly drain the parts after washing, and dry with filtered compressed air.

4–318. INSPECTION.

a. Visually examine all threads for corrosion or damage.

b. Inspect machined surfaces for burrs, nicks and scratches.

c. Inspect the valve and valve seat for evidence of wear and uneven seating.

4–319. REPAIR AND REPLACEMENT.

a. Replace the entire valve, if any internal parts are damaged or worn.

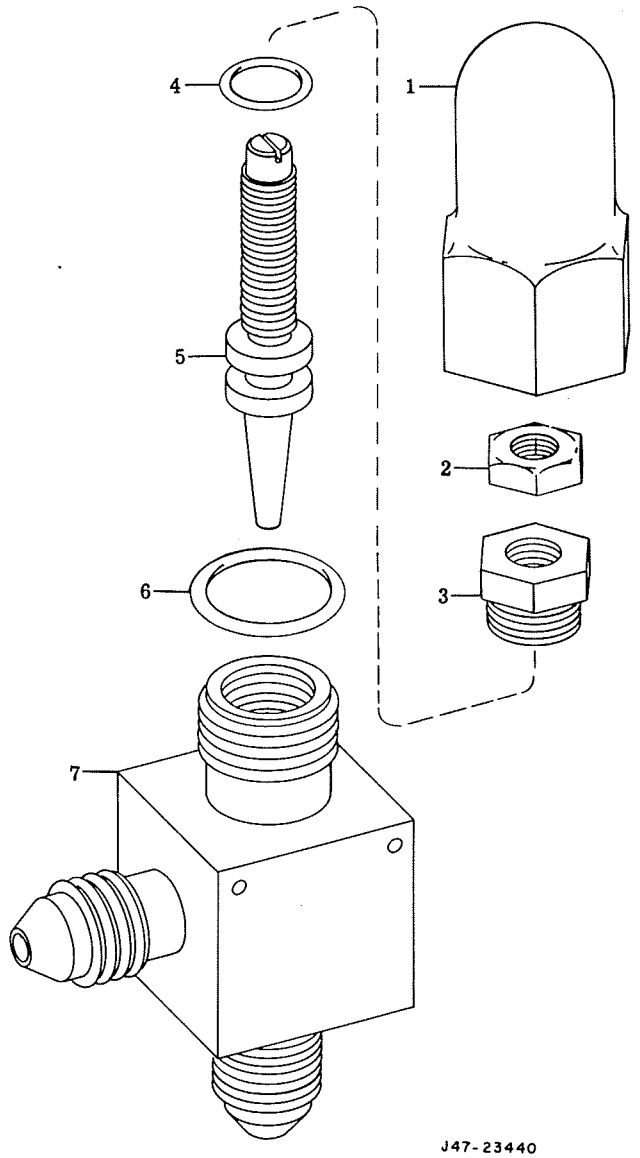
b. Replace the "O" rings if necessary.

c. Minor thread damage may be repaired with a fine file.

4–320. LUBRICATION. No lubrication is required.

4–321. REASSEMBLY. (See figure 4–122.)

a. Reassembly is the reverse of disassembly.



1. Sealing Nut
2. Jam Nut
3. Bushing
4. "O" Ring
5. Stem
6. "O" Ring
7. Valve Body

Figure 4–122. Fuel Regulator Valve Assembly, Exploded View

b. Torque bushing (3) to 80-100 lb in. and jam nut (2) to 30-60 lb in. Stake bushing (3) in 3 places.

c. Install new curing date decal if new "O" rings are installed.

4–322. TEST PROCEDURE. (See figure 4–122.)

a. Instrument accuracy for torque of 0–80 lb in. will be ± five lb in.

b. For test fluid, use Specification MIL–F–5616 at room temperature.

c. Remove sealing nut (1) and loosen jam nut (2).

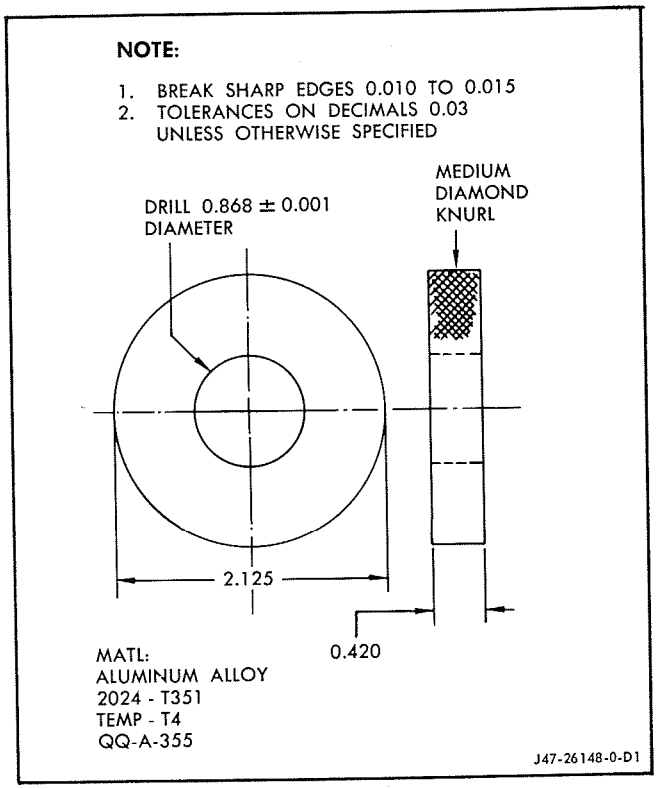


Figure 4-122A. Diaphragm Puller Support Ring

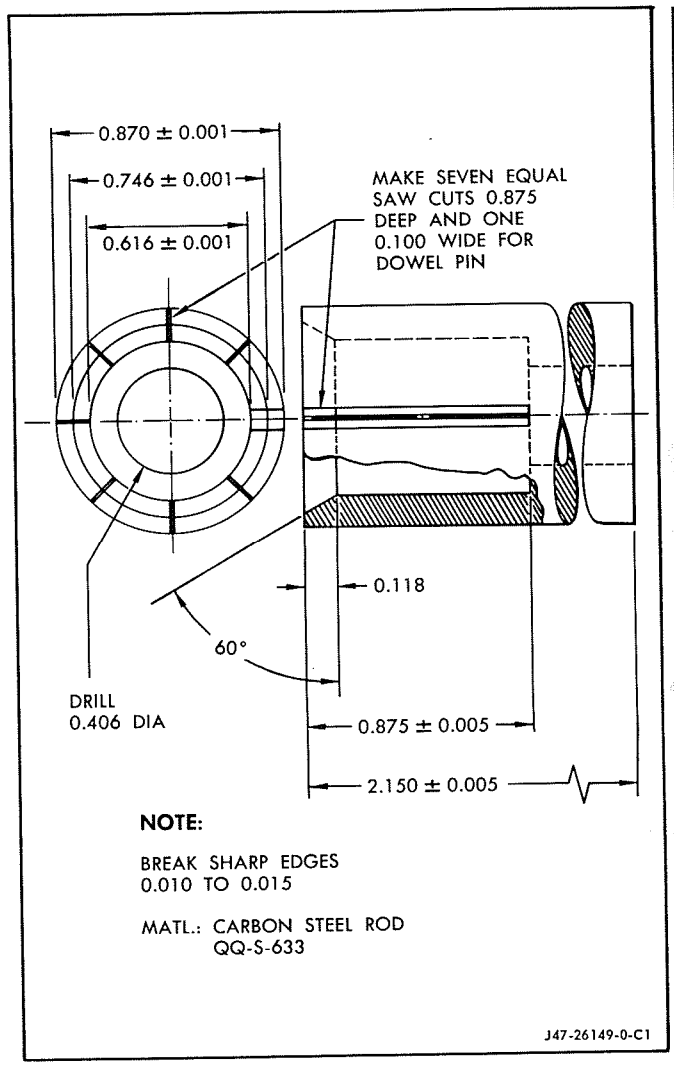


Figure 4-122B. Diaphragm Puller Expander

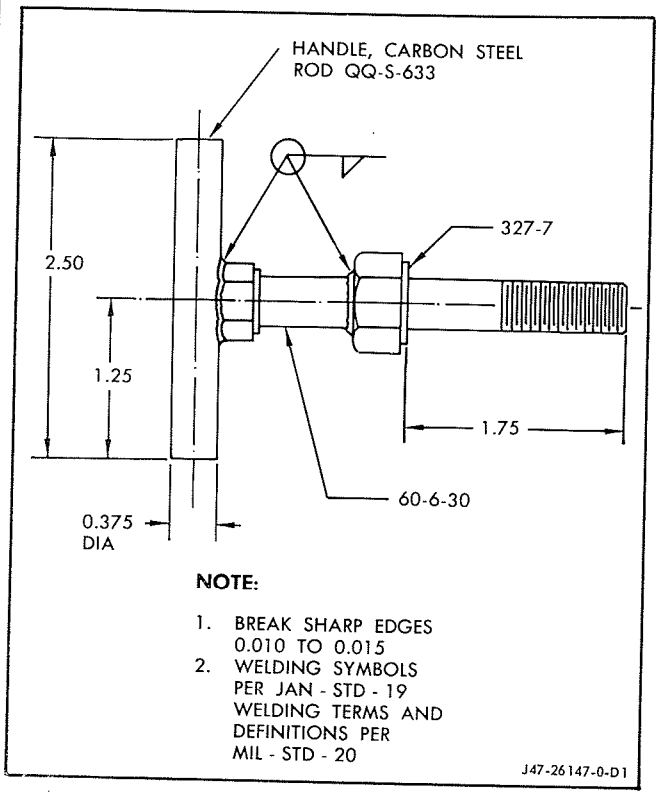


Figure 4-122C. Diaphragm Puller Expander Assembly Drive

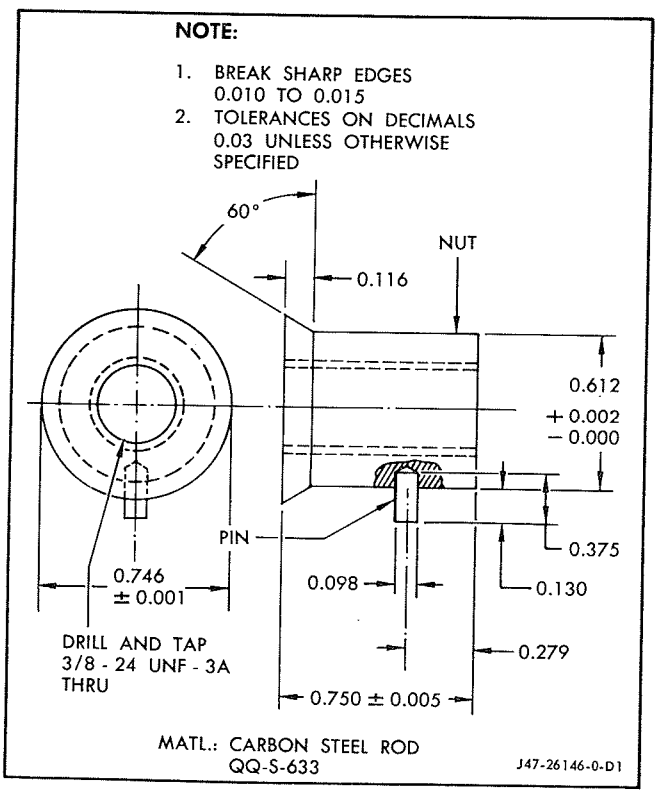


Figure 4-122D. Diaphragm Puller Expander Assembly Nut

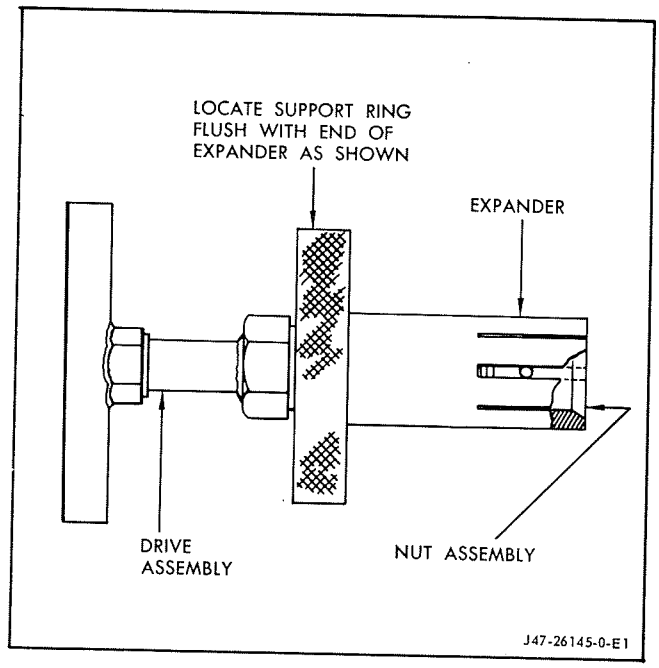


Figure 4-122E. Diaphragm Puller Assembly

d. Seat valve stem (5); turn counterclockwise 3 full turns.

e. Allow fuel to flow through the valve to purge valve of air.

f. Cap one port and apply 900-1000 psi (gage) for one minute to the other port. There must be no leakage.

g. Reseat valve stem and torque jam nut to 30-60 lb in.

4-322A. FUEL PRESSURE CONTROL VALVE.

4-322B. GENERAL. The following paragraphs contain minor repair instructions for fuel pressure control valve assemblies, part No. 021098-033 (Pesco) series, and part No. 9300-B2 (Chandler-Evans) series (figures 4-124A and 4-124B).

4-322C. SPECIAL TOOLS. No special tools are required to disassemble or to assemble the control valve. However a diaphragm puller locally manufactured in accordance with figures 4-122A, 4-22B, 4-122C, 4-122D and 4-122E will be beneficial in removing the diaphragm from the valve assembly.

4-322D. DISASSEMBLY. Disassembly of fuel pressure control valves at field maintenance level is limited to removal and replacement of the diaphragm assembly. Disassemble in order of index numbers shown in figure 4-124A for 02198-033 series valves and figure 4-124B for 9300-B2 series valves.

CAUTION

Do not remove regulator valve or sleeve from the housing assembly, since this will cause the control valve to malfunction.

4-322E. CLEANING. Remove all traces of old gaskets from mating parts by scraping. Clean parts with dry cleaning solvent, Federal Specification P-S-661. Precaution shall be taken to assure cleanliness of all mating parts. These are close clearance parts susceptible to malfunction due to contamination.

4-322F. INSPECTION. Inspect bolts and tapped holes for damaged threads. Inspect mating surfaces of housings and covers for nicks and scratches; burnish or stone as necessary.

4-322G. REPAIR AND REPLACEMENT. Replace gaskets and diaphragm assembly.

4-322H. LUBRICATION. No lubrication is required.

4-322J. REASSEMBLY. Reassemble the fuel pressure control valve in the reverse order of disassembly. See figure 4-124A for 021098-033 series valves and figure 4-124B for 9300-B2 series valves.

Note

Check for correct part number on new diaphragm assembly, part No. 14097 for 9300-B2 valves and part No. 102-1099 for 021098-033 valves. Take precautions to ensure that the oil side of the diaphragm is facing the regulator (VCO) piston. Identification "oil side" is stamped on the assembly; however, if this marking is obliterated, the rough side of the rubber diaphragm is the "oil side" and the smooth side of the rubber diaphragm is the fuel side.

CAUTION

Apply proper and even torque to the 6 bolts holding the piston cover to the valve housing assembly to assure no distortion or cocking of parts which could cause the VCO piston to hang or give sticky operation. Torque limit is 50-60 pound-inches for 9300-B2 valves and 70-75 pound-inches for 021098-033 valves.

4-322K. TESTING. Install the valve on an engine and check top speed rpm and throttle burst acceleration time.

4-323. MAIN FUEL CHECK VALVE ASSEMBLY.

4-324. GENERAL. The following paragraphs contain minor repair instructions for main fuel check valve assembly, Part No. 414B481 (figure 4-123). The main fuel check valve assembly opens into both the main and emergency fuel systems. Fuel from the system with the higher pressure enters through its inlet port and seats the flapper-type check valve on the inlet of the lower pressure system. The check valve is spring loaded and requires between 5 and 8 psi (gage) to unseat it.

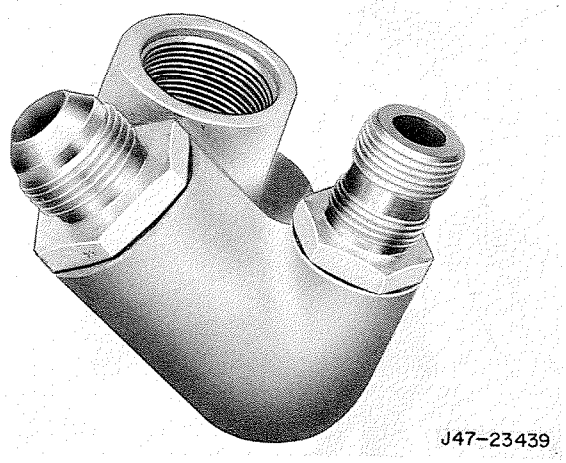


Figure 4-123. Main Fuel Check Valve Assembly

4–325. SPECIAL TOOLS. No special tools are required to assemble or disassemble the valve.

4–326. DISASSEMBLY. Disassemble in the same order as the index numbers shown in figure 4–124. Do not disassemble the swing subassembly from cap (1).

4–327. CLEANING. Wash all parts thoroughly with cleaning solvent, Federal Specification P–S–661, using a soft brush. Drain the parts after washing and dry with filtered compressed air.

4–328. INSPECTION. (See figure 4–124.)

a. Inspect cap (1) seat for scratches, nicks, or other damage affecting sealing.

b. Inspect bosses on cap for burrs, nicks, or other damage affecting free-swinging action of swing (3).

c. Check body (6) and union (7) for cracks, deformation, or other structural damage. Check condition of all threads.

4–329. REPAIR AND REPLACEMENT. (See figure 4–124.)

a. The valve body (6) usually requires little repair work. Repair is limited to removal of nicks, burrs, and the straightening of threads.

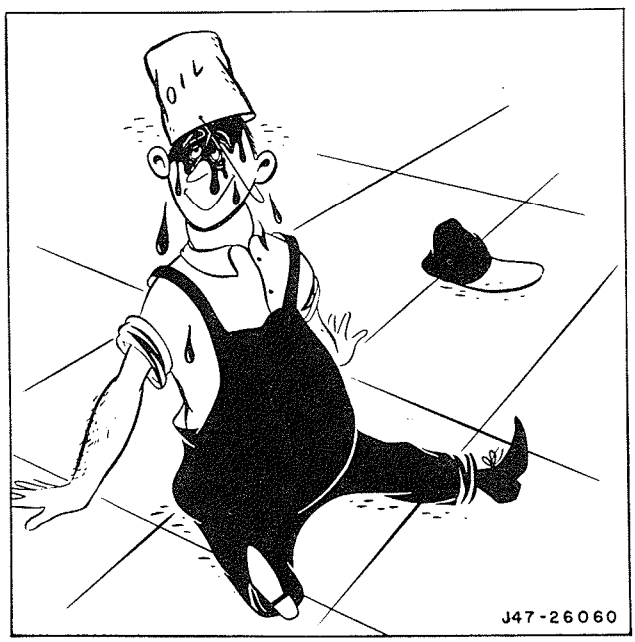
b. Replace entire valve assembly if any components are damaged.

c. Replace "O" rings (5, 8) if necessary.

4–330. LUBRICATION. No lubrication is required.

4–331. REASSEMBLY. Reassembly is the reverse of disassembly. (See figure 4–124.)

a. Torque cap subassembly (1) to 150 lb in. and union (7) to 100 lb in.



b. Install new curing date decal if new "O" rings are installed.

4–332. TEST PROCEDURE.

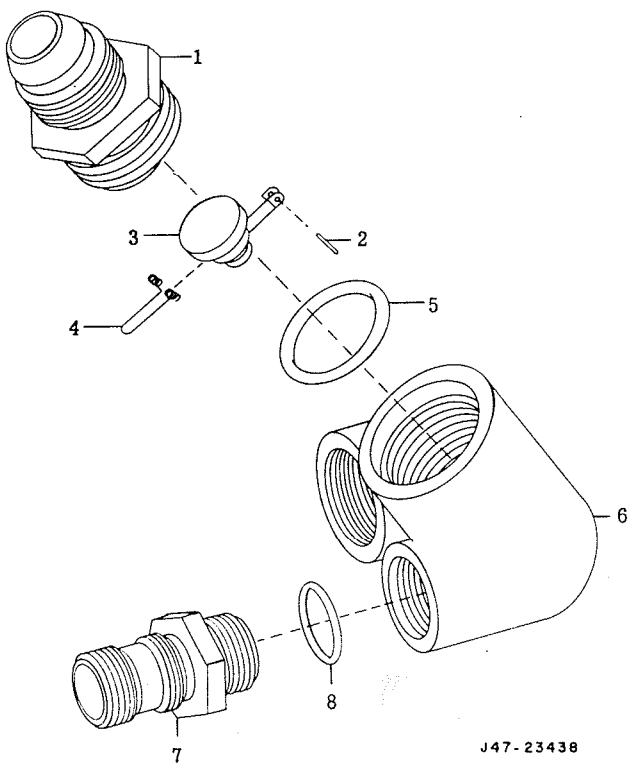
a. Test the main fuel check valve assembly functionally on the engine; observe carefully for leakage after engine shut down.

4–332A. FUEL PUMPS.

4–332B. GENERAL. The following paragraphs contain minor repair instructions for fuel pump assemblies, part No. 1P–739 and 2P–739 (Pesco) series and part No. 9200–A3 (Chandler-Evans) series. (See figures 4–124C and 4–124D.)

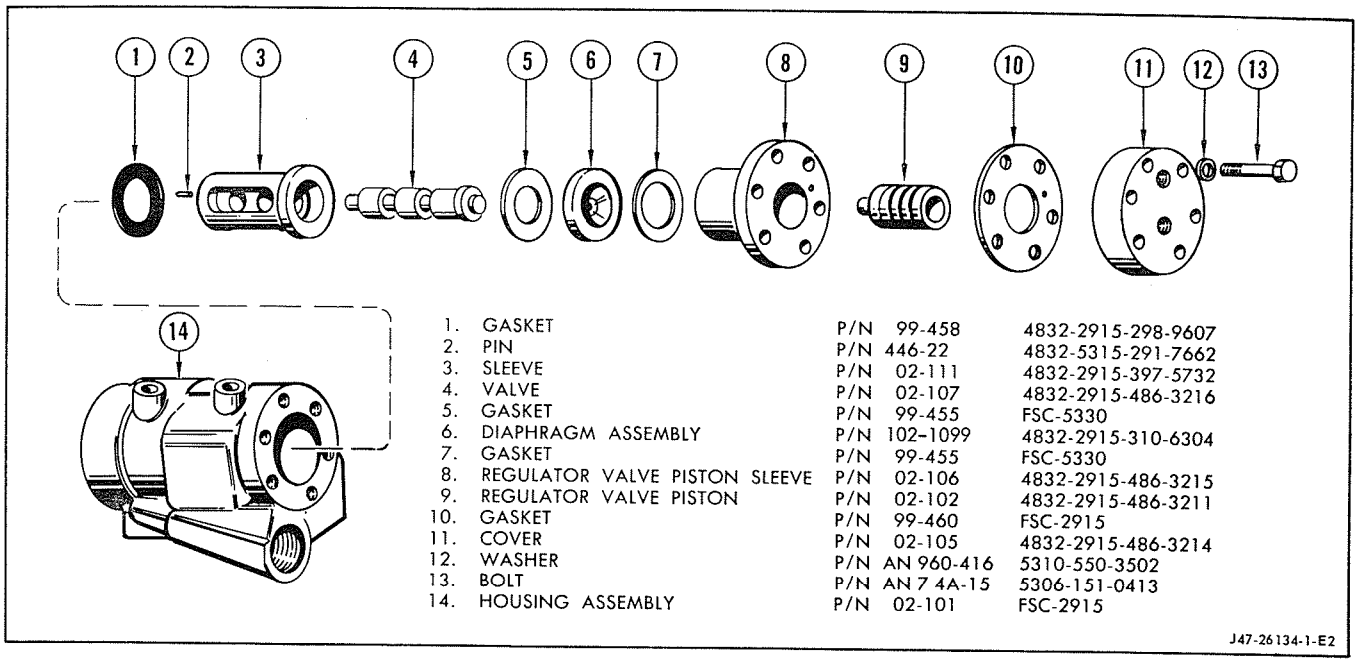
4–332C. SPECIAL TOOLS. No special tools are required to disassemble or assemble these pumps.

4–332D. DISASSEMBLY. Disassembly of fuel pumps at field maintenance level is limited to removal and replacement of the drive shaft and attaching parts. Disassemble in order of index numbers given in figure 4–124C for 1P–739 and 2P–739 pumps and figure 4–124D for 9200–A3 pumps.



1. Cap (Subassembly)
2. Hinge Pin
3. Swing (Subassembly)
4. Spring
5. "O" Ring
6. Valve Body
7. Union
8. "O" Ring

Figure 4–124. Main Fuel Check Valve Assembly, Exploded View



1.	GASKET	P/N 99-458	4832-2915-298-9607
2.	PIN	P/N 446-22	4832-5315-291-7662
3.	SLEEVE	P/N 02-111	4832-2915-397-5732
4.	VALVE	P/N 02-107	4832-2915-486-3216
5.	GASKET	P/N 99-455	FSC-5330
6.	DIAPHRAGM ASSEMBLY	P/N 102-1099	4832-2915-310-6304
7.	GASKET	P/N 99-455	FSC-5330
8.	REGULATOR VALVE PISTON SLEEVE	P/N 02-106	4832-2915-486-3215
9.	REGULATOR VALVE PISTON	P/N 02-102	4832-2915-486-3211
10.	GASKET	P/N 99-460	FSC-2915
11.	COVER	P/N 02-105	4832-2915-486-3214
12.	WASHER	P/N AN 960-416	5310-550-3502
13.	BOLT	P/N AN 7 4A-15	5306-151-0413
14.	HOUSING ASSEMBLY	P/N 02-101	FSC-2915

Figure 4–124A. Fuel Pressure Control Valve (Pesco) 021098–033 Series

1.	BOLT	P/N AN 74 A15	5306-151-0413
2.	WASHER	P/N AN 960-416	5310-550-3502
3.	COVER	P/N 13122	4811-2915-211-4879
4.	GASKET	P/N 13121	4811-2915-397-5644
5.	REGULATOR VALVE PISTON	P/N 13120	4811-2915-211-4878
6.	REGULATOR VALVE PISTON SLEEVE	P/N 13119	4811-2915-211-4877
7.	PREFORMED PACKING	P/N MS 29513-132	5330-265-1085
8.	GASKET	P/N 13112	4811-5330-298-6800
9.	DIAPHRAGM ASSEMBLY	P/N 14097	4811-2915-211-4885
10.	GASKET	P/N 13112	4811-5330-298-6800
11.	REGULATOR VALVE	P/N 13111	4811-2915-314-6162
12.	HOUSING ASSEMBLY	P/N 13103	4811-2915-096-5545

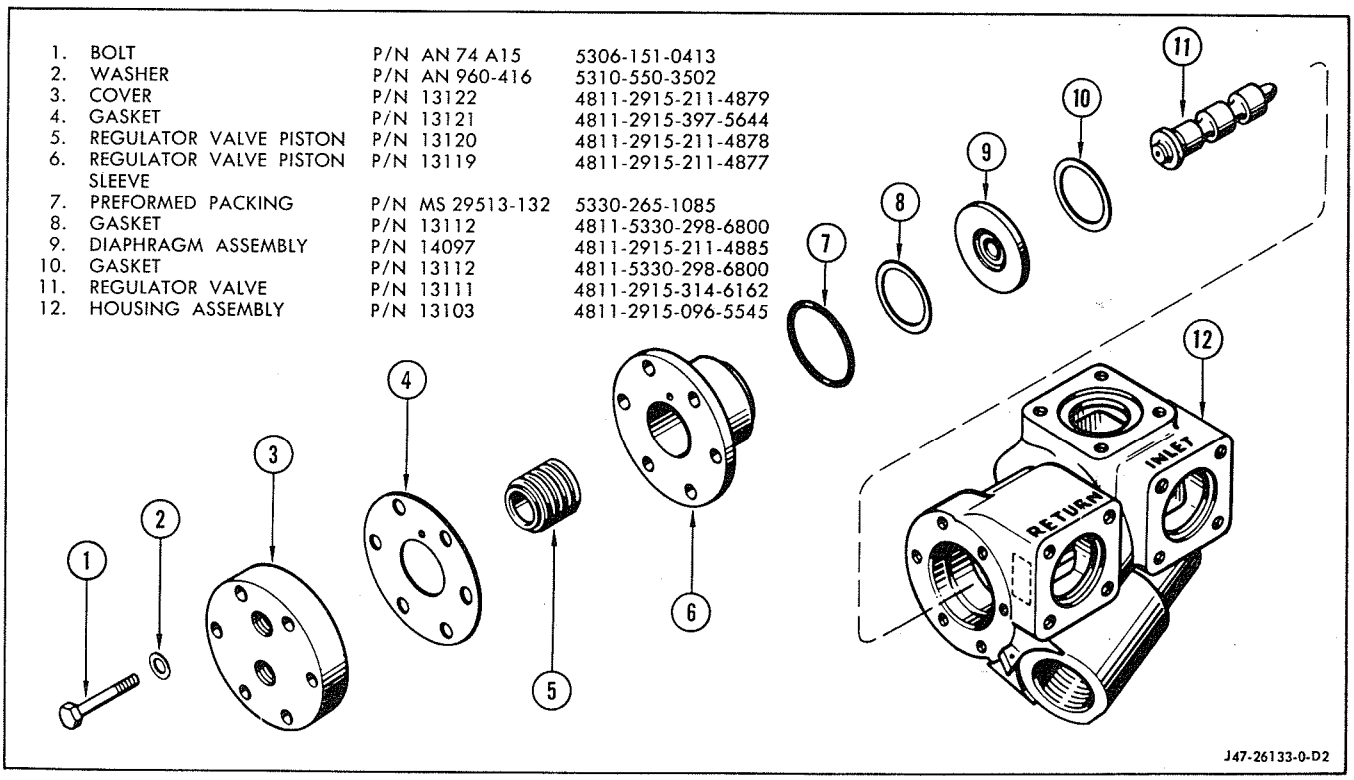
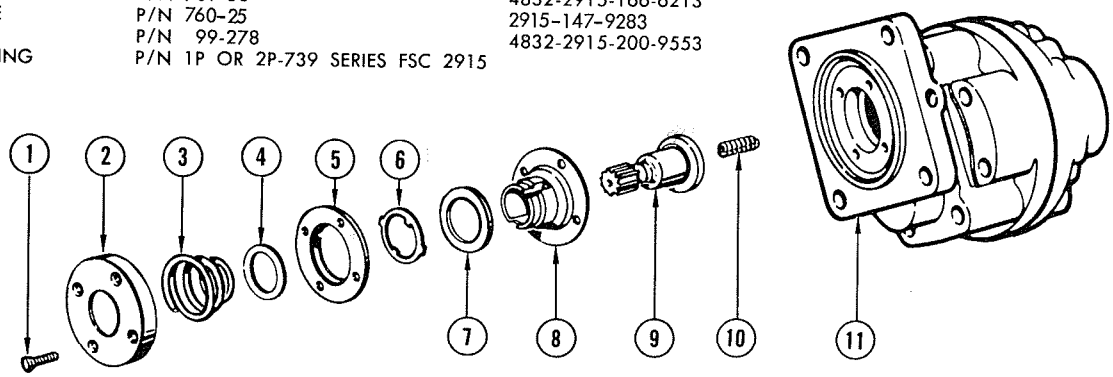


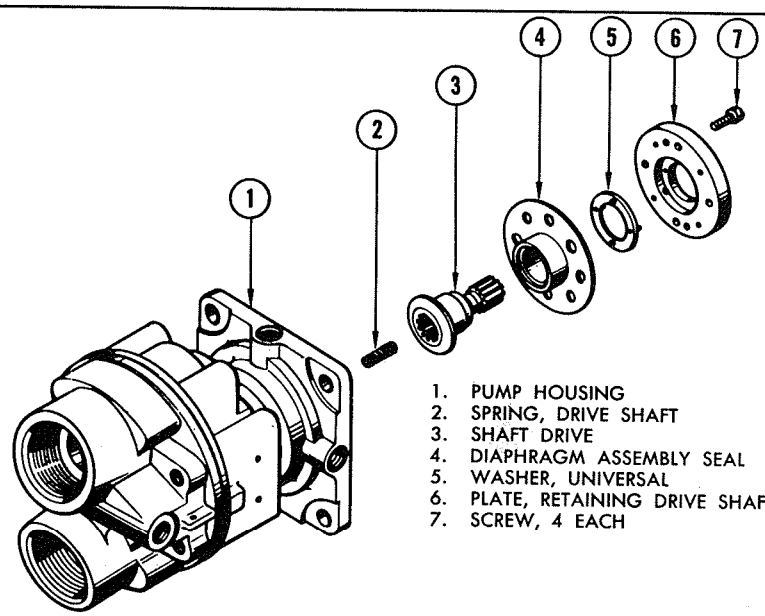
Figure 4–124B. Fuel Pressure Control Valve (Chandler-Evans) 9300–B2

1.	SCREW, STEEL, 4 EACH	P/N M400-15	4832-5305-207-3010
2.	PLATE THRUST	P/N 739-50	4832-2915-166-6111
3.	SPRING	P/N 99-277	4832-2915-599-9873
4.	WASHER	P/N 99-276	4832-5310-095-2695
5.	STOP DIAPHRAGM	P/N 739-51	4832-2915-166-5406
6.	WASHER	P/N 739-54	4832-5310-166-5405
7.	GUIDE DIAPHRAGM	P/N 739-53	2915-166-6228
8.	DIAPHRAGM ASSEMBLY	P/N 739-56	4832-2915-166-6213
9.	SHAFT DRIVE	P/N 760-25	2915-147-9283
10.	SPRING	P/N 99-278	4832-2915-200-9553
11.	PUMP HOUSING	P/N 1P OR 2P-739 SERIES FSC 2915	



J47-26135-1-E2

Figure 4–124C. Fuel Pump Assembly 1P or 2P–739 (Pesco)



1.	PUMP HOUSING	P/N 9200-A3	4811-2915-202-5874
2.	SPRING, DRIVE SHAFT	P/N 13259	4811-2915-328-2378
3.	SHAFT DRIVE	P/N 13260	4811-2915-328-2379
4.	DIAPHRAGM ASSEMBLY SEAL	P/N 13261	4811-2915-328-2380
5.	WASHER, UNIVERSAL	P/N 13265	4811-2915-328-2381
6.	PLATE, RETAINING DRIVE SHAFT	P/N 13266	FSC-2915
7.	SCREW, 4 EACH	P/N 1251	4302-5305-484-6639

J47-26136-0-E2

Figure 4–124D. Fuel Pump Assembly 9200–A3 (Chandler-Evans)

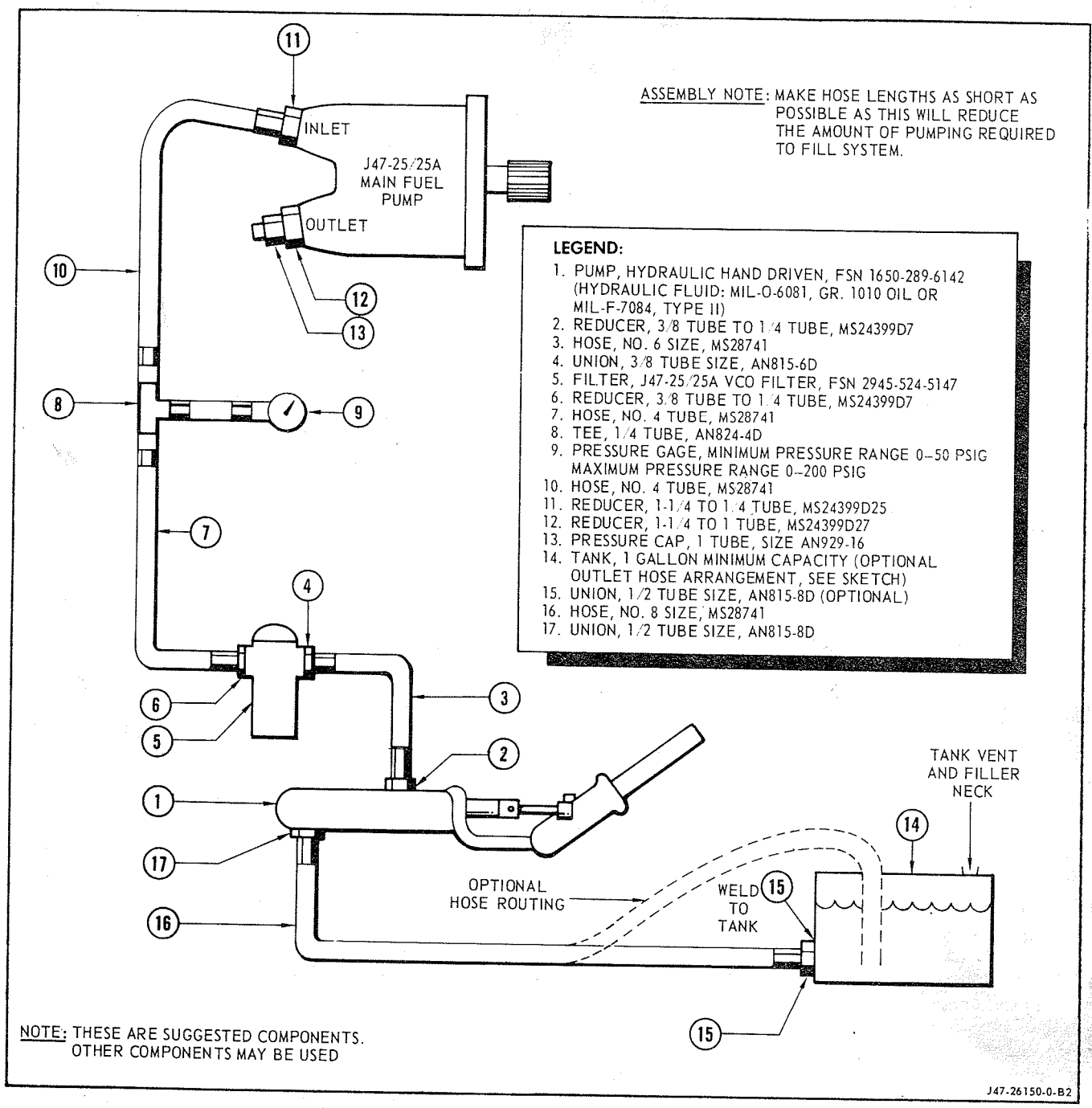

ASSEMBLY NOTE: MAKE HOSE LENGTHS AS SHORT AS POSSIBLE AS THIS WILL REDUCE THE AMOUNT OF PUMPING REQUIRED TO FILL SYSTEM.
INLET
J47-25/25A MAIN FUEL PUMP
OUTLET
LEGEND:
1. PUMP, HYDRAULIC HAND DRIVEN, FSN 1650-289-6142 (HYDRAULIC FLUID: MIL-O-6081, GR. 1010 OIL OR MIL-F-7084, TYPE II)
2. REDUCER, 3/8 TUBE TO 1/4 TUBE, MS24399D7
3. HOSE, NO. 6 SIZE, MS28741
4. UNION, 3/8 TUBE SIZE, AN815-6D
5. FILTER, J47-25/25A VCO FILTER, FSN 2945-524-5147
6. REDUCER, 3/8 TUBE TO 1/4 TUBE, MS24399D7
7. HOSE, NO. 4 TUBE, MS28741
8. TEE, 1/4 TUBE, AN824-4D
9. PRESSURE GAGE, MINIMUM PRESSURE RANGE 0-50 PSIG MAXIMUM PRESSURE RANGE 0-200 PSIG
10. HOSE, NO. 4 TUBE, MS28741
11. REDUCER, 1-1/4 TO 1/4 TUBE, MS24399D25
12. REDUCER, 1-1/4 TO 1 TUBE, MS24399D27
13. PRESSURE CAP, 1 TUBE, SIZE AN929-16
14. TANK, 1 GALLON MINIMUM CAPACITY (OPTIONAL OUTLET HOSE ARRANGEMENT, SEE SKETCH)
15. UNION, 1/2 TUBE SIZE, AN815-8D (OPTIONAL)
16. HOSE, NO. 8 SIZE, MS28741
17. UNION, 1/2 TUBE SIZE, AN815-8D
TANK VENT AND FILLER NECK
OPTIONAL HOSE ROUTING
WELD TO TANK
NOTE: THESE ARE SUGGESTED COMPONENTS. OTHER COMPONENTS MAY BE USED
J47-26150-0-B2

Figure 4-124E. Main Fuel Pump Shaft Seal-Static Leakage Check System

4-332E. CLEANING. Wash all parts thoroughly with cleaning solvent (P-S-661) using a stiff brush. Dry all parts with moisture-free compressed air. For drive shafts previously coated with dry film lubricant, use a non-flammable type epoxy paint stripping compound to remove residue of lubricant from the spline.

4-332F. INSPECTION. Inspect shaft splines for wear as follows:

a. Use two No. 29 pins (drill shanks 0.1359-0.1361 inch in diameter) 1/4 inch maximum length.

b. Place the two No. 29 pins between the spline teeth exactly 180° apart. Measure the dimension over the pins using a one inch micrometer, calibrated to 0.0001 inch (FSN 5210-221-1930 or equivalent). Record measurement.

c. Move pins 90° from position in step "b" and obtain measurement.

d. If the average of the two measurements is less than 0.8250 inch, reject the shaft for excessive spline wear.

e. Inspect shoulder of drive shaft (figure 4-124C-9) and face of diaphragm (8) for corrosion. Remove corrosion using 600-grit emery paper in accordance with paragraph H-332J. Reject parts exhibiting excessive pitting which cause excessive leakage (reference paragraph 4-32K).

4-332G. REPAIR AND REPLACEMENT. No repair is required. Replace drive shafts having spline wear in excess of allowable limits. Install a new diaphragm assembly when the drive shaft is replaced.

4-332H. LUBRICATION. Lubricate as follows:

a. Apply dry film lubricant to drive shaft splines using Molykote No. X-106 or equivalent. Molykote No. X-106 can be ordered from the Alpha Molykote Corp., 65 Harvard Ave., Stamford, Conn. One quart of the lubricant will coat approximately 50 shaft splines.

b. Apply as follows:

(1) Thoroughly clean and degrease acceptable shafts with trichloroethylene, using a brush and clean cloth. It is very important that all dirt, grease and corrosion be removed from the shaft. Do not touch the spline area after cleaning. Cleaned shafts should be handled with clean cotton gloves.

(2) Cover the shaft seal rubbing areas with masking tape or other suitable covering.

(3) Thoroughly stir the dry film lubricant mixture before pouring into spray gun container. Adjust the spray gun to a very fine spray.

Note

Do not allow lubricant mixture in gun to set longer than 10 minutes without stirring or shaking.

(4) After the spline area is completely dry, spray on a very light coating of the lubricant mixture. A coating thickness on the order of 0.0003-0.0005 inch is desirable for optimum life. One pass with the spray gun produces a thickness of approximately 0.0002 inch. Make one pass over each uncoated area of the spline until the spline area is uniformly covered. Allow this coating to air dry for three minutes before applying second coat. The distance of the gun nozzle should be such that the mixture arrives wet on the spline surface without causing running or rippling. If the gun is held too far from the spline area, resins will arrive partially dry and a defective bonding may result. This condition is recognized by a powdery appearance during this application.

Note

If it is necessary to remove uncured coating, wipe the spline with acetone or methyl-ethyl-ketone. Large lumps, drips or runs may be shaved down with a razor blade.

WARNING

The above solvents are highly flammable. Use proper precautions. Avoid prolonged inhalation of their fumes.

(5) Allow coating to air dry for a minimum of five minutes before handling. Remove masking tape, taking care to avoid damaging the uncured coating. Handle the non-coated end of the shaft.

(6) Place the shaft in an oven and bake (cure) for two hours at a temperature of 350°F.

c. Apply liberal quantities of Plastilube No. 3 (FSN 9150-823-8045) to the treated male spline and to the female spline prior to installing the pump on the engine.

CAUTION

Do not pack grease in the female spline recess, the pump can be damaged.

d. Coat the sealing surface of the new diaphragm with oil (MIL-O-6081, Grade 1010) prior to installation.

4-332J. REASSEMBLY. Reassemble the fuel pump in reverse order to disassembly. (See figure 4-124C for 1P or 2P-739 series and figure 4-124D for 9200-A3 series pumps.)

CAUTION

Make sure that guide, diaphragm (7) (see figure 4-124C) is installed during reassembly. It is possible to inadvertently omit the guide.

Note

The new diaphragm assembly should be wet lapped to remove any chemical coating or foreign material from the sealing surface. Use a flat surface and 600-grit emery paper submerged in solvent, Federal Specification P-S-661. Reduce excessive sharpness of emery paper surface by rubbing 2 sheets face to face or by breaking the sheets over a hard steel plate. A "figure 8" movement should be used.

4-332K. TESTING. Install the reworked fuel pump on an engine and check for leaks by running the engine 15 minutes at 75 percent rpm. Retard the throttle to idle rpm and check for leakage by removing overboard drain line at the pump drain port. The maximum permissible leakage is 6 cc per minute. If fuel leakage exceeds the maximum limit, remove pump from the engine and wet lap the sealing surface of the diaphragm assembly as outlined in the Note in paragraph 4-332J.

4-332L. STATIC LEAKAGE TEST (OPTIONAL).

This test may be used to check pump leakage prior to installation but does not eliminate dynamic testing required by paragraph 4-332K.

a. Attach fuel pump to the system as shown in figure 4-124E.

b. Check hydraulic fluid level in tank (14), 1 gallon minimum.

c. Open tank vent.

d. Loosen or remove pressure cap (13) from main fuel pump.

e. Start pumping and continue pumping until hydraulic fluid comes from the main fuel pump outlet.

f. Tighten pressure cap (13).

g. Continue pumping until pressure reaches 30 psig.

h. Check for main fuel pump leakage.

i. If excessive leakage occurs, rework in accordance with paragraph 4-332J or replace diaphragm.

4-332M. FUEL FILTER (AIR-MAZE 03512166D).

4-332N. DISASSEMBLY OF FUEL FILTER.

a. Unscrew the sump (1, figure 4-124F) from the body assembly (14), unscrew the filter element assembly (2), and remove the O ring (9).

b. Disassemble the filter element assembly in the following manner: Remove the nut (5), tabwasher (6), and retainer cup (7) from the center tube assembly (8). Remove the 12 filter packs (3) and the 11 spacers (4).

4-332O. CLEANING FUEL FILTER.

a. Immerse all parts except the filter packs in cleaning solvent, (P-S-661). If necessary, use a brush to clean the part thoroughly. Allow the parts to drain and dry them with a lint-free cloth.

b. Clean the 12 filter packs with a soft hair brush dipped in the cleaning solvent.

CAUTION

Do not use a wire brush on any part of the filter assembly.

c. Blow through the filter parts with dry compressed air.

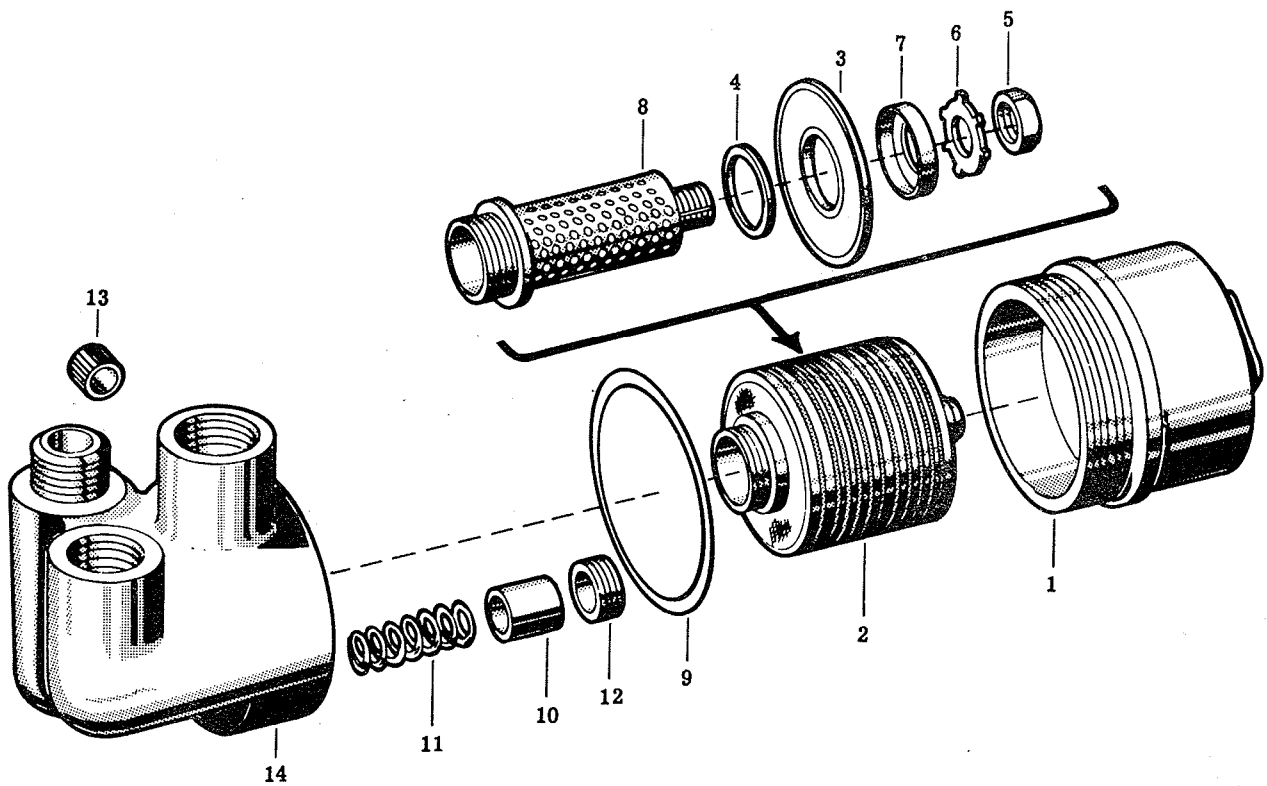
Note

Do not use compressed air on the filter element.

4-332P. ASSEMBLY OF FUEL FILTER. (See Figures 4-124F and 4-124G.)

Note

In the reassembly of the fuel filter new "O" rings will be installed.



J47-22126

Figure 4-124F. Fuel Filter (Air-Maze 03512166D)

a. Reassemble the filter element assembly by alternately installing a filter pack (3, figure 4–124F) and a spacer (4) on the center tube assembly (8). Secure with the retainer cup (7), tabwasher (6), and nut (5). The torque value of the nut to the retainer cup is 30–35 pound–inches.

b. Install the O ring (9) in the body assembly and screw the filter element assembly (2) onto the body assembly. The torque value of the filter to the body assembly is 75–90 pound–inches.

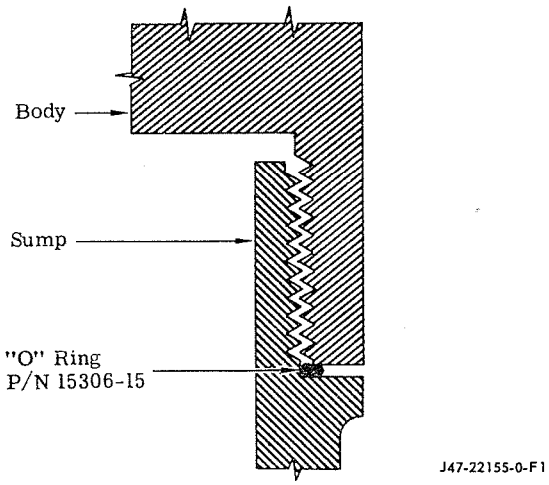


Figure 4-124G. Installation of O-Ring, P/N 15306–15, in Air-Maze Filter

c. Screw the sump onto the body assembly, using anti-seize compound, AN–G 14) on the fuel filter sump threads. The torque value of the fuel filter sump to the body assembly is 170–200 pound–inches.

4–332Q. FUEL FILTER (HYDRO-AIRE 3638A).

4–332R. DISASSEMBLY OF FUEL FILTER.

a. Remove the lockwire and unscrew the nut (6, figure 4–124H) from the bolt (8) and remove the washer (7).

b. Remove the bowl (10) and detach the ring (11) from the body assembly (20).

c. Remove the ring (12), washer (13), spring (14), washer (15), and ring (16) from the bolt (8).

d. Withdraw the cotter pin (9) and remove the seal (17) and ring (21) from the bolt (8).

e. Disassemble the filter element assembly by separating the 8 elements (19) and 7 spacers (18) and remove the spacers and elements from the bolt.

Note

Remove any clips present in the filter element assemblies and classify these clips as unserviceable. Do not install new clips.

f. Remove the bolt (8) from the body assembly (20).

4-332S. CLEANING FUEL FILTER. Same as for Air-Maze Model 03512166D. Refer to paragraph 4-3320.

4–332T. ASSEMBLY OF FUEL FILTER. (See figures 4–124H and 4–124I.)

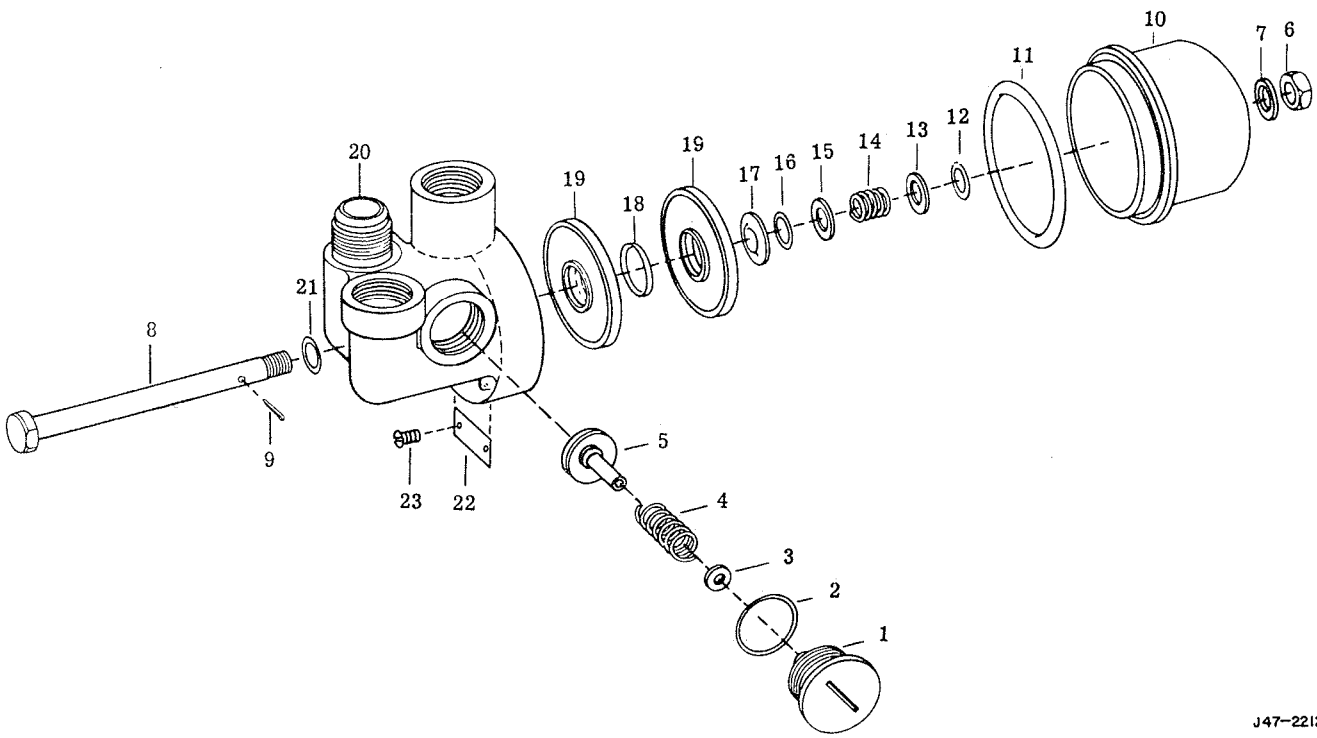


Figure 4–124H. Fuel Filter (Hydro-Aire 3638A)

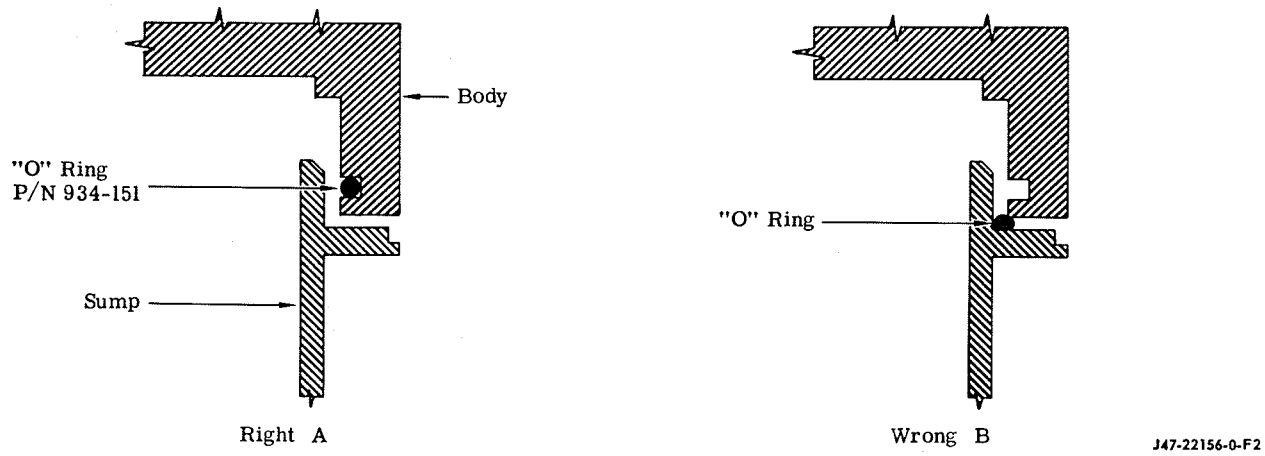


Figure 4-124I. Installation of O-Ring, P/N 934-151, in Hydro-Aire Filter

Note

In the reassembly of the fuel filter new "O" rings will be installed.

a. Install the ring (21, figure 4-124H) on the bolt (8) and install the bolt and ring in the body assembly (20).

b. Assemble the 8 elements (19) and the 7 spacers (18) on the bolt (8) and install the seal (17) and the cotter pin (9) on the bolt.

c. Install the ring (16), washer (15), spring (14), washer (13), and ring (12), on the bolt.

d. Install the ring (11 in the body assembly (20).

Note

Make sure that the ring (11) is installed in the recessed groove in the body assembly.

e. Assemble the bowl (10) to the body assembly (20) making sure the bowl is seated properly and is not pinching the ring, and install the washer (7) and the nut (6) on the bolt. Torque to 300-350 inch-pounds.

4-332U. MODIFICATION OF CONNECTOR-TEE.

4-332V. If not already accomplished, modify combustion chamber drain connector tee P/N 8482877 by removing retainer P/N 8482877-1 and screen 8482877-2. (See figure 4-124J). Remove staking damage to connector body by removal of high metal.

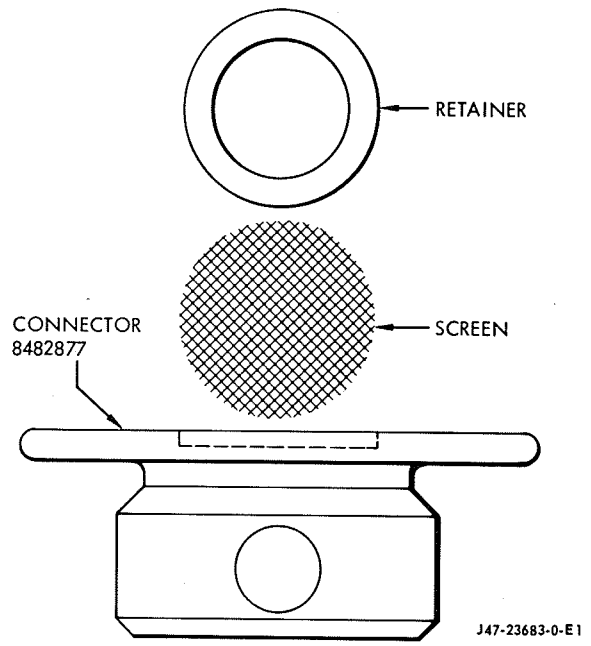


Figure 4-124J. Connector — Tee Side Outlet

4-333. LUBRICATION SYSTEM.

4-334. Minor repair of lube and scavenge pumps, oil coolers, and oil check valves are items which may be found herein.

4-335. AFT FRAME SCAVENGE OIL FILTER.

4-336. GENERAL. The following paragraphs contain minor repair instructions for the Aft Frame Scavenge Oil Filter, Part No. 9482079, which filters aft frame scavenged oil.

4-337. SPECIAL TOOLS. No special tools are required.

4-338. DISASSEMBLY. Do not disassemble the oil filter. If defective, replace as a unit.

4-339. CLEANING. Immerse filter screen in cleaning solvent, Federal Specification P-S-661. Use a brush to get parts thoroughly clean. Allow part to drain before drying with a lint-free cloth.

4-340. INSPECTION. Visually inspect filter screen. If the screen in torn, ruptured, or broken, replace the part.

4-341. REPAIR AND REPLACEMENT.

a. Modification of filter screen to prevent ingestion of loose foreign objects by the aft lube scavenge pump. Modify the filter screen as shown in figure 4-124K.

b. Replace the part if screen is torn, ruptured or broken.

4-342. LUBRICATION. None required.

4-343. REASSEMBLY. None required.

4-344. TEST PROCEDURE. None required.

4-345. REGULATOR OIL FILTER ASSEMBLIES.

4-346. GENERAL. The following paragraphs contain minor repair and test instructions for the Regulator Oil Filter Assemblies Part No. OS12223-G and Part No. 3856. The regulator oil filter meters and filters the flow of oil. This component contains a filter element and an orifice through which the lube oil is metered at the rate of one to one-and-one-half quarts per minute.

4-347. LEADING PARTICULARS.

a. Flow through the filter must be 1-1.5 quarts per minute with a differential pressure of 13-15 psi.

b. The filter must stop all particles more than 0.0015 inch in diameter.

4-348. SPECIAL TOOLS. None required.

4-349. DISASSEMBLY. Disassemble in the order of index numbers shown in figures listed below:

a. Model No. OS12223-G per figure 4-125.

b. Model No. 3856 per figure 4-126.

4-350. CLEANING.

a. Immerse all parts except the filter elements in cleaning solvent, Federal Specification P-S-661. Use a brush to get the parts thoroughly clean. Allow the parts to drain before drying them with a clean, lint-free cloth.

b. Clean the filter elements with a soft bristle brush dipped in cleaning solvent, Federal Specification P-S-661.

NOTE

Drying the filter elements with compressed air is not recommended.

c. Blow dry compressed air through the openings in the body.

4-351. INSPECTION. Inspect all parts for damaged threads and the body bowl for cracks.

4-352. REPAIR AND REPLACEMENT.

a. Replace the "O" rings if necessary.

b. Inspect each filter pack carefully. If the fine screen-filtering material is torn, ruptured, or broken, replace the part.

4-353. LUBRICATION. Coat the threads of the sump with anti-seize compound, Specification MIL-L-25681.

4-354. REASSEMBLY. Assemble in the reverse order of the index numbers on the figures listed below:

a. Model No. OS12223-G per figure 4-125.

(1) Torque - Nut (3) to 10-15 lb-in.; sump to body, 40-60 lb-in.; orifice assembly sump, 40-50 lb-in.

b. Model No. 3856 per figure 4-126.

(1) Torque - Nut (1) to 40-60 lb-in.

4-355. TEST PROCEDURE.

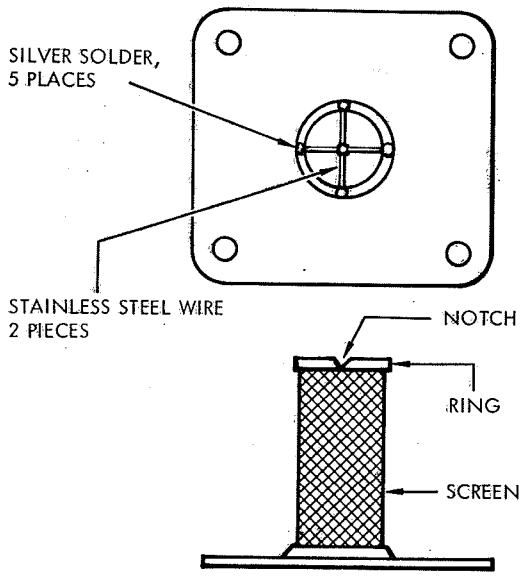
a. Test the Regulator Oil Filter functionally on the engine; observe carefully for leakage after engine shut down.

4-356. LUBE OIL FILTER ASSEMBLY.

4-357. GENERAL. The following paragraphs contain overhaul and test instructions for the Lube Oil Filter Assemblies, Part No. C15575K and Part No. 3690, which filters foreign particles from the lubrication oil.

4-358. SPECIAL TOOLS. None required.

4-359. DISASSEMBLY. Disassemble in the order of index numbers shown in figures listed below:



PROCEDURE:

1. THOROUGHLY CLEAN PART.
2. NOTCH IN 4 PLACES, APPROXIMATELY 90° APART AND APPROXIMATELY 0.035 INCH DEEP AS SHOWN.

CAUTION

DO NOT MELT BRAZE JOINT HOLDING SCREEN TO RING.

3. SOLDER WIRES IN PLACE AS SHOWN, AND GRIND ENDS FLUSH WITH OUTSIDE DIAMETER OF RING.
4. SOLDER WIRES TOGETHER AT INTERSECTION.
5. REMARK PART BY ELECTRIC ETCHING A "-1" FOLLOWING THE PART NUMBER (DO NOT USE METAL STAMP).

MATERIALS:

1. WIRE, STAINLESS STEEL, 1/32 INCH DIAMETER FSN 9505-640-4290 OR EQUIVALENT
2. SILVER SOLDER FSN 3439-184-8951, OR EQUIVALENT
3. FLUX AMX 3410 (LACO OR EQUIVALENT)

J47-26154-0-E2

Figure 4-124K. Modification of Scavenge Oil Filter Screen, P/N 9482079

a. Model No. C3690 per figure 4-127.
b. Model No. C15575K per figure 4-128.

4-360. CLEANING.

a. Immerse all parts except the filter cartridge and gaskets in cleaning solvent, Federal Specification P-S-661. Use a brush to get the parts thoroughly clean. Allow the parts to drain before drying them with a lint-free cloth.

b. Blow dry compressed air through the openings in the body. Clean the filter cartridge or elements with a soft-bristle brush dipped in cleaning solvent, Federal Specification P-S-661.

Note

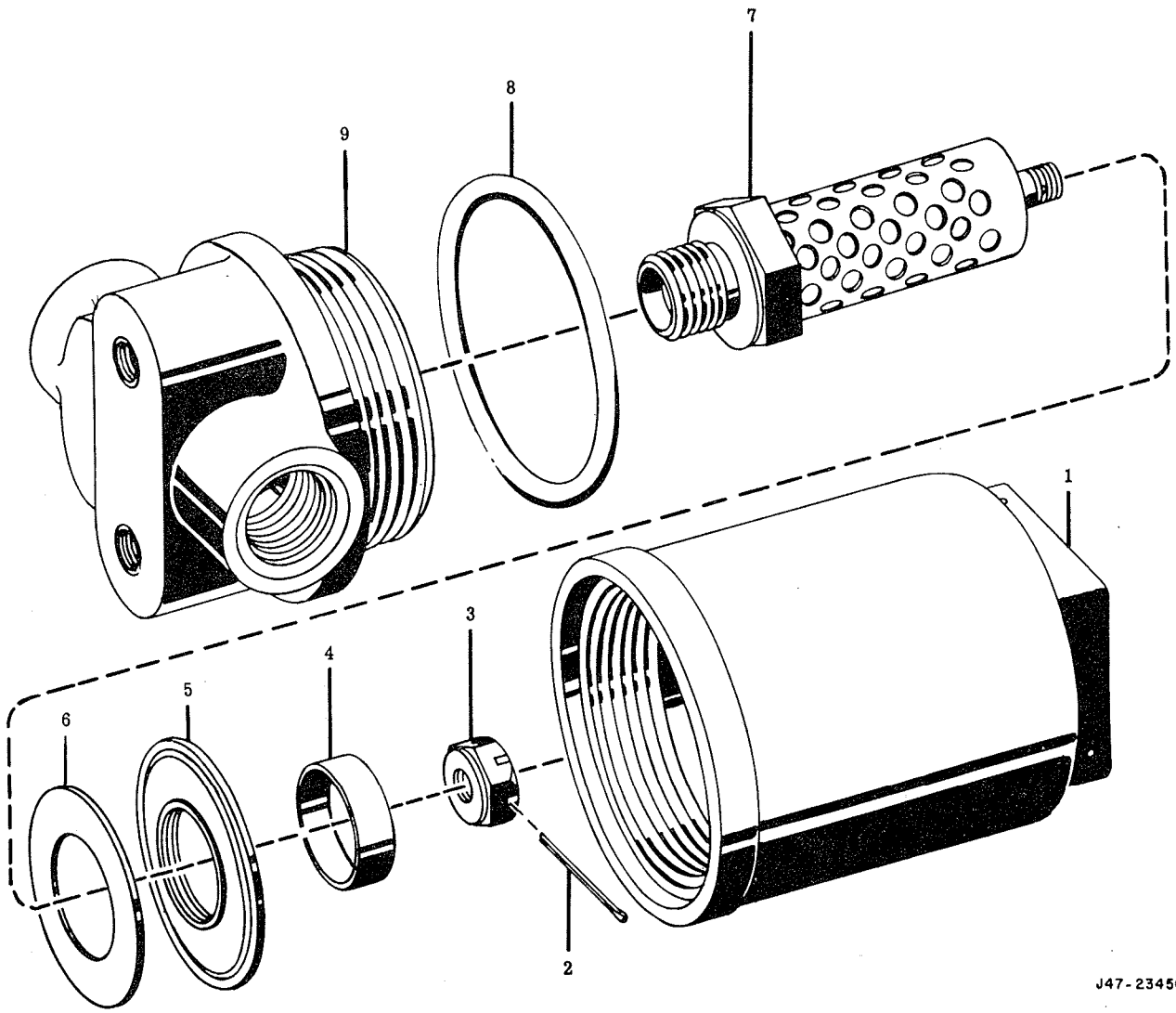
Drying the filter elements with compressed air is not recommended.

4-361. INSPECTION.

a. Inspect the cover and body of the filter for cracks or damaged threads.

b. Visually inspect filter cartridge. There must be no breaks in screening.

c. Inspect the relief valve and seat for burrs.



1. Sump
2. Cotter Pin
3. Castle Nut
4. Retainer Cup
5. Filter Pack
6. Washer
7. Orifice Assembly
8. "O" Ring
9. Body

Figure 4-125. Exploded View of Regulator Oil Filter Assembly, Model No. OS12223-G

4-362. REPAIR AND REPLACEMENT.

a. Replace cartridge assembly if damaged.

b. Replace the "O" rings if necessary.

c. Remove burrs with a fine stone.

4-363. LUBRICATION. No lubrication is required.

4-364. REASSEMBLY. Reassemble in the reverse order of the index numbers on the figures listed below:

a. Model 3690 per figure 4-127.

b. Model C15575K per figure 4-128.

c. Torque the following for each model to the values below:

(1) Torque cover nut 70-80 lb-in. (Model C15575K).

(2) Torque seal nut 25-30 lb-in. (Model C-15575K).

(3) Torque cover seat 90-110 lb-in. (Model 3690).

d. Lockwire as required.

4-365. TEST PROCEDURE.

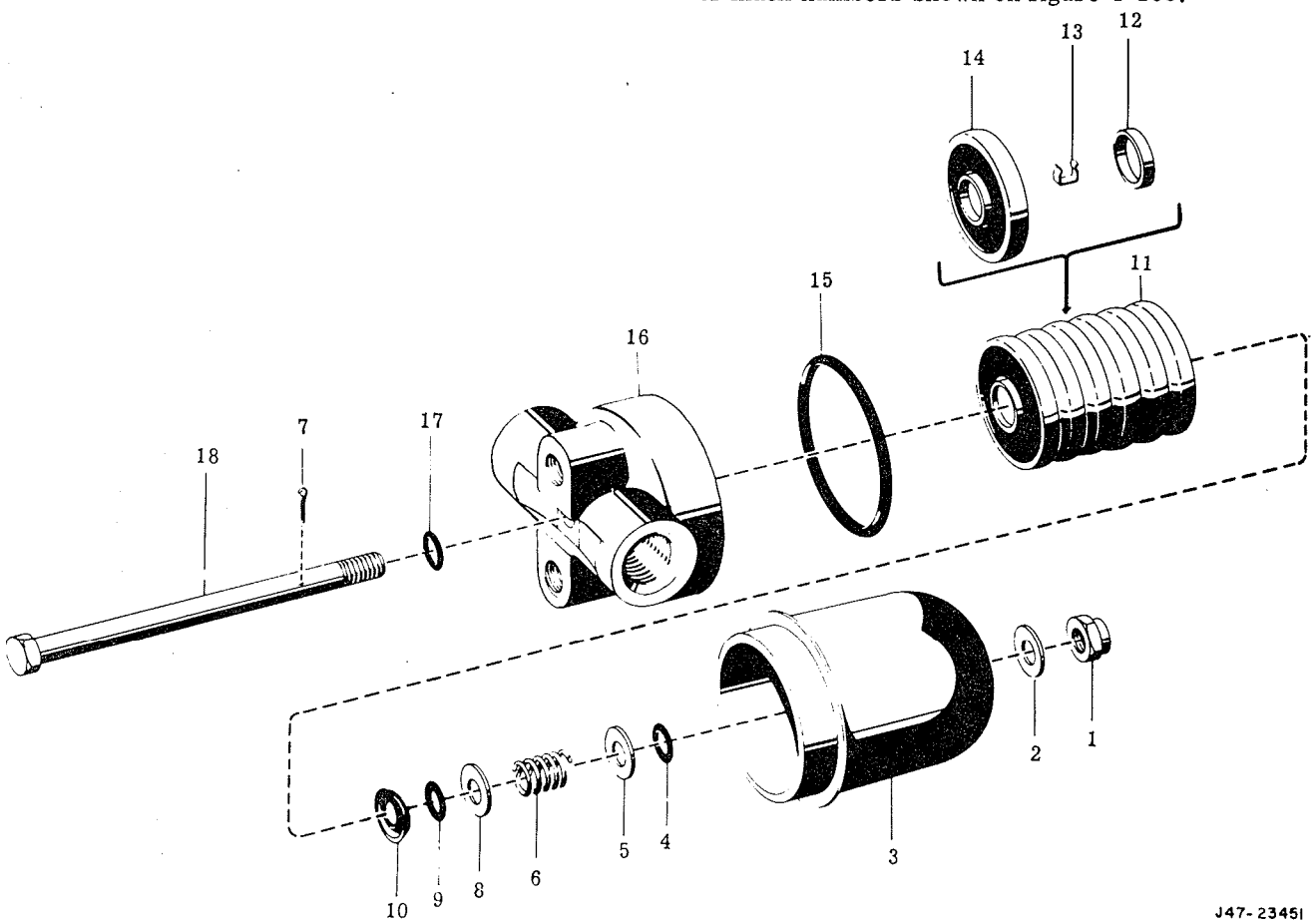
a. Test the Lube Oil Filter Assembly functionally on the engine and observe carefully for leakage.

4-366. CHECK VALVES (CONE TYPE).

4-367. GENERAL. The following paragraphs contain minor repair instructions for Check Valve, Model Nos. 1207-10-6, 1112-518221 and 1112-526057.

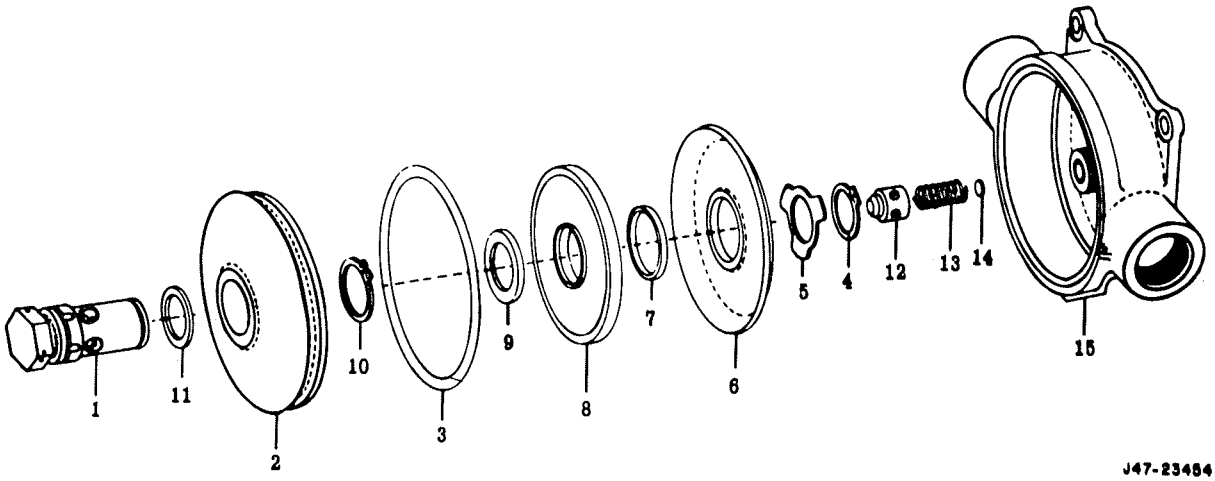
4-368. SPECIAL TOOLS. None required.

4-369. DISASSEMBLY. Disassemble in the order of index numbers shown on figure 4-130.



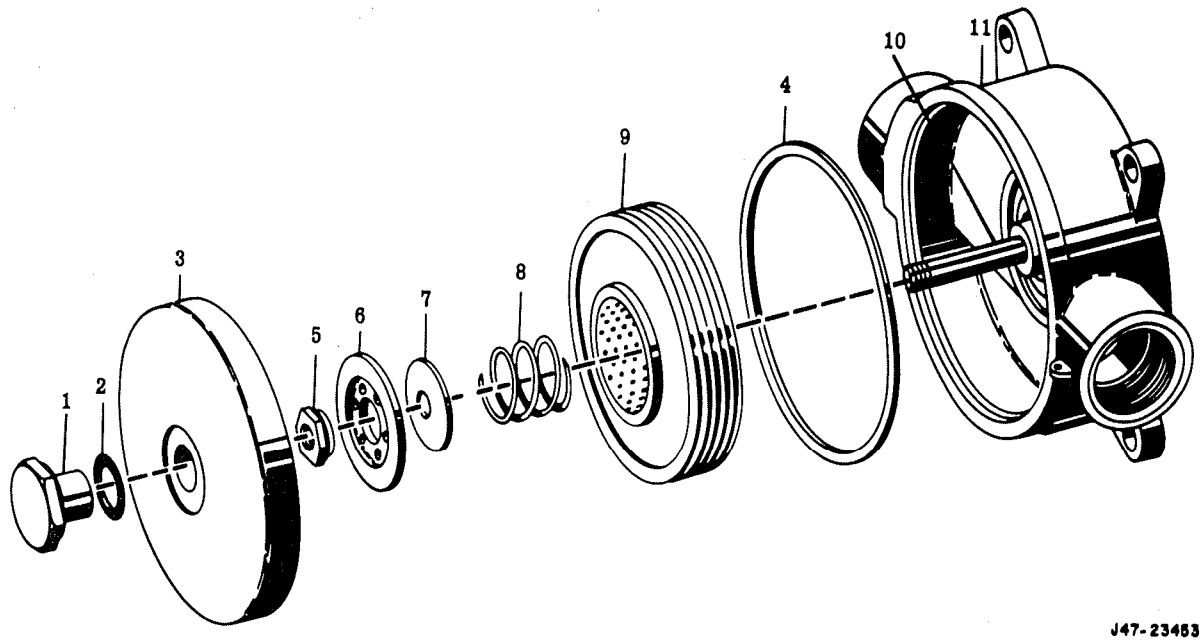
1. Self-Locking Nut
2. Washer
3. Bowl
4. "O" Ring
5. Washer
6. Spring
7. Cotter Pin
8. Washer
9. "O" Ring
10. Seal
11. Element
12. Spacer
13. Clip
14. Disc Assembly
15. "O" Ring
16. Body Assembly
17. "O" Ring
18. Bolt

Figure 4-126. Exploded View of Regulator Oil Filter Assembly, Model 3856



1. Seat
2. Cover
3. Packing
4. Retainer Ring
5. Support
6. Baffle
7. Spacer
8. Filter Element
9. Collar
10. Retainer Ring
11. Packing
12. Poppet
13. Spring
14. Shim
15. Body

Figure 4–127. Exploded View of Lube Oil Filter Assembly, Model 3690



1. Seal Nut
2. "O" Ring
3. Cover
4. Gasket
5. Sleeve Nut
6. Relief Valve Seat
7. Relief Valve
8. Relief Valve Spring
9. Cartridge Assembly
10. Stud
11. Body

Figure 4–128. Exploded View of Lube Oil Filter Assembly, Model C–15575K

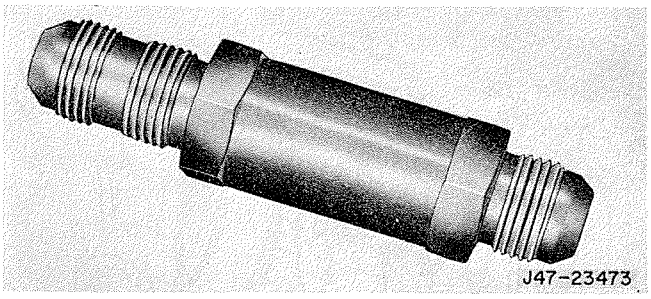
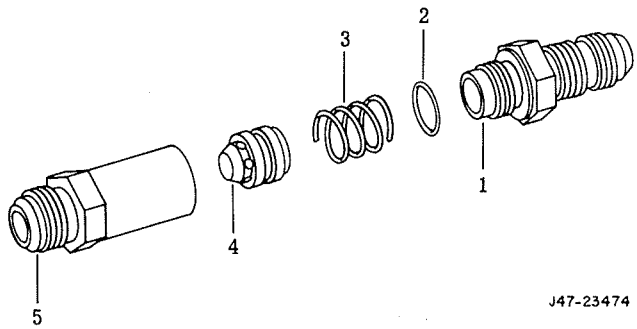


Figure 4-129. Check Valve, Model No. 1112-518221 or Model No. 1207-10-6



1. Cap
2. "O" Ring
3. Spring
4. Cone
5. Body

Figure 4-130. Check Valve, Exploded View, Model No. 112-518221 or 1207-10-6

4-370. CLEANING. Wash parts with cleaning solvent, Federal Specification P-S-661. Dry with compressed air.

4-371. INSPECTION. (See figure 4-130.)

a. Examine cone (4) for nicks, scoring, or excessive wear.

b. Check spring (3) for breaks or cracks.

c. Examine threads for scoring or cross-threading.

d. Check flare ends for scoring, dents, or nicks.

e. Check for hang-up of cone (4) caused by excessively worn or scored cylinder walls of valve body (5) by moving cone (4) in and out of body (5) with tip of finger while slowly rotating it relative to body.

4-372. REPAIR AND REPLACEMENT.

a. Replace the entire assembly if any parts are damaged.

b. Replace "O" ring if necessary.

4-373. LUBRICATION. Immerse the "O" ring in hydraulic oil, Specification MIL-O-5606.

4-374. REASSEMBLY.

a. Reassemble in the reverse order of index numbers on figure 4-130.

b. Torque body (5) to 30-35 lb-in.

4-375. TEST PROCEDURE.

a. Test the Check Valve functionally on the engine and observe carefully for leakage.

4-376. COMPRESSOR FRONT FRAME CHECK VALVE ASSEMBLY.

4-377. GENERAL. The following paragraphs contain minor repair instructions for Compressor Front Frame Check Valve Assembly, Model No. 9493088 (figure 4-131). The check valve permits oil in the gear case oil supply line to flow in only one direction.

4-378. SPECIAL TOOLS. None required.

4-379. DISASSEMBLY.

NOTE

Do not disassemble this check valve.

4-380. CLEANING. Wash the valve in cleaning solvent, Federal Specification P-S-661. Dry with compressed air.

4-381. INSPECTION. (See figure 4-132.)

a. Check threads for scoring, cross-threading, burrs, and nicks.

b. Examine rubber seal (7) for deterioration.

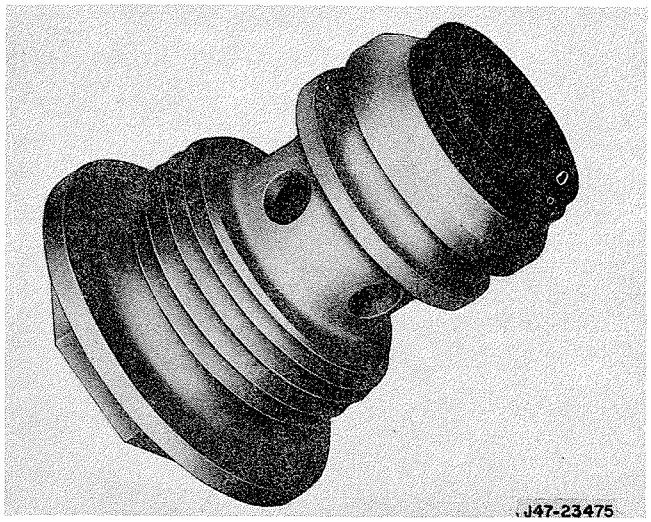


Figure 4-131. Compressor Front Frame Check Valve Assembly, Model No. 9493088

c. Inspect bolthead of valve for excessive wear.

d. Check spring (5) for cracks or breaks by raising seal cover once or twice against spring tension.

4-382. REPAIR AND REPLACEMENT.

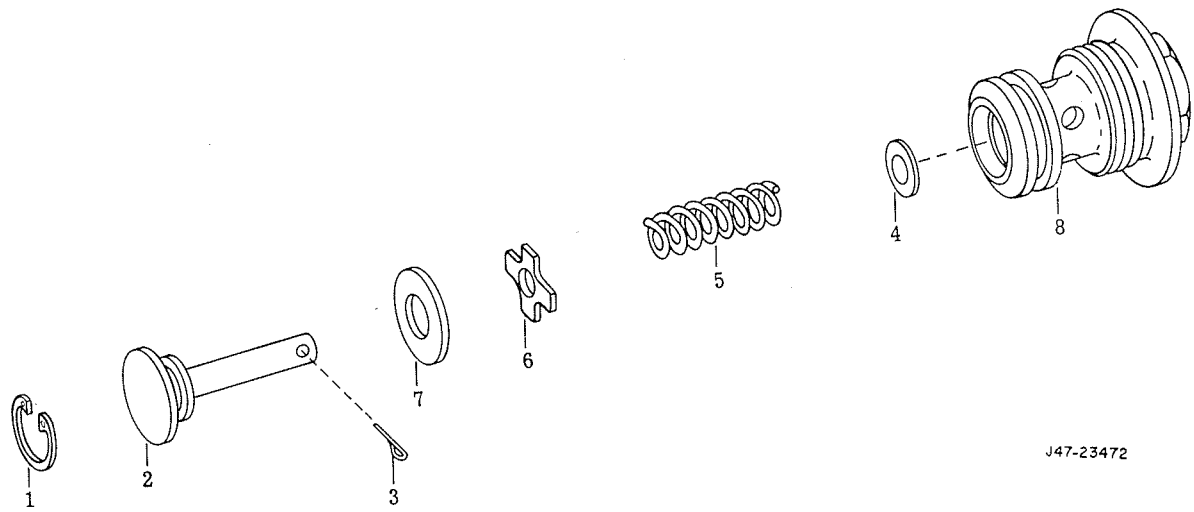
a. Replace entire valve if any parts are damaged.

b. Repair minor thread damage with a fine file.

4-383. LUBRICATION. None required.

4-384. REASSEMBLY. None required.

4-385. TEST PROCEDURE. Test the valve functionally on the engine and observe carefully for leakage after engine shut down.



1. Snap Ring
2. Check Valve Stem
3. Cotter Pin
4. Washer
5. Spring
6. Valve Spring Seat
7. Rubber Seal
8. Check Valve Body

Figure 4-132. Compressor Front Frame Check Valve Assembly, Exploded View

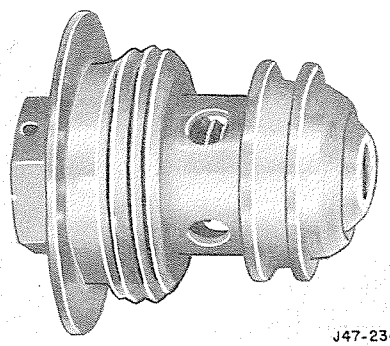


Figure 4-133. Relief Valve Assembly, Model No. 131B208

4-386. RELIEF VALVE ASSEMBLY.

4-387. GENERAL. The following paragraphs contain minor repair instructions for Relief Valve Assembly, Model No. 131B208 (figure 4-133), which relieves pressure in the gear case oil supply line if it exceeds operational limits.

4-388. SPECIAL TOOLS. None required.

4-389. DISASSEMBLY. This valve cannot be disassembled. Replace as a unit if necessary.

4-390. CLEANING. Wash the valve in cleaning solvent, Federal Specification P-S-661. Dry with compressed air.

Note

Also clean the strainer screen.

4-391. INSPECTION.

a. Inspect threads for scoring, cross-threading, nicks, and burrs.

b. Check the bolthead of the valve for excessive wear.

4-392. REPAIR AND REPLACEMENT.

a. Replace with a new valve if threads are cross-threaded or excessively scored.

b. Replace with a new valve if bolthead is worn excessively.

4-393. LUBRICATION. None required.

4-394. TEST PROCEDURE. Test the Relief Valve functionally and observe carefully for leakage after engine shut down.

4-395. IGNITION SYSTEM VIBRATOR UNIT, P/N 9791211G4. Where there is interference with the engine cowling, cut approximately 3/8 inch off of the toggle switch handle and deburr rough edge.

SECTION V
ASSEMBLY OF SUBASSEMBLIES

5-1. GENERAL.

5-2. COVERAGE. This section presents steps necessary for reassembling each major engine subassembly.

5-3. CLEANLINESS. Cleanliness is of the utmost importance in assembly. To protect finely machined surfaces and prevent foreign material from lodging in tubes and drilled passages, do not remove wrapping until necessary. Do not remove plugs or caps from any openings until necessary.

a. Keep the entire working area, inspection benches and tools clean. Keep all components free of dust, dirt and grease. All bearings will be protected when removed. Cap openings in components with protective closures. Use polyethylene storage bags for small components, if necessary. Inspect parts under adequate light as this is necessary to truly evaluate damage. Tag each component to indicate repair or replacement. Inspect nuts, bolts, clamps, brackets and related hardware for defects and discard non-serviceable parts. Numerous parts can be visually examined for external defects, but others require the use of micrometers, dial indicators and various types of measuring instruments or gauges. These precision tools must be kept in closed boxes or plastic covers and be calibrated at regular intervals.

5-4. PRECAUTIONS.

a. During assembly exercise extreme care not to drop pieces of lockwire, nuts, washers, or other objects into subassembly. If an object is dropped, stop all work until it is located and removed.

b. Handle bearings at all times in accordance with instructions in Specification MIL-P-1978 and in accordance with paragraph 4-62 of this handbook.

c. All lockwiring must be done in accordance with instructions in paragraph 5-6.

d. Use new O-rings, non-metallic gaskets, locknuts, and lockwire throughout assembly.

e. See Section VIII, for special torque values required. Where possible, torque all nuts, screws and bolts on diametrically opposite planes. Do not exceed maximum listed torque.

f. Refer to Illustrated Parts Breakdown for detailed information on parts to be used.

g. Use specified anti-seize compound, if required, on each screw, stud, and bolt during assembly.

h. The engine is precision-built and requires careful handling. Lift all heavy parts with a suitable chain hoist.

i. When using an arbor press, place a fiber or plastic block between engine part and base of press to prevent damage to the part.

5-5. CHILLING OF ENGINE PARTS FOR ASSEMBLY. The following procedure is recommended to prepare engine parts for assembly.

a. Have a container of adequate size to hold dry ice (MIL-BB-C-104).

b. Place a water-tight container in the dry ice and fill with alcohol, Specification MIL-A-6091.

c. Immerse part in the alcohol for the required chilling time.

Note

The advantage of this procedure over merely putting part to be chilled directly into dry ice is elimination of condensation on the surface.

5-6. LOCKWIRING. Refer to MS33540 for information pertaining to General Practices for Safety Wiring.

Figure 5-1. Deleted

5-7. ALTERNATOR DRIVE MOUNT.

5-8. ASSEMBLY OF THE ALTERNATOR DRIVE MOUNT.

a. Grease the surface of the housing bore in the mount pad with a light coat of lubricant, Specification MIL-G-23827.

b. Install the O-ring seal to the bottom of housing bore.

c. Install the O-ring seal to the alternator drive shaft housing behind the mounting flange.

d. Install the alternator drive housing assembly to the mount pad, and secure it with 4 bolts and washers. Refer to Section VIII, Reference No. 80 for torque value, and lockwire in groups of 2.

Note

This housing can be installed in only one position due to off-center mounting holes. This position assures alignment of oil inlet opening in alternator drive housing with oil port on mount pad.

e. Install shipping cover to the alternator mount pad. Secure with 4 screws and washers. Refer to Section VIII, Reference No. 79 for torque value. Lockwire with a single strand of wire.

f. Install 90-degree elbow to the oil inlet port on mount pad, using O-ring seal and jam nut. Refer to Section VIII table XLVIII for torque value.

g. Install 90-degree elbow to the oil outlet port (6 o'clock position on front of the mount pad) using O-ring seal and jam nut. Refer to Section VIII, table XLVIII for torque value.

5-9. COMPRESSOR FRONT FRAME.

5-10. ASSEMBLY OF MISCELLANEOUS PARTS TO THE COMPRESSOR FRONT FRAME.

Note

Throughout this paragraph numbers in parentheses, refer to figure 5-2 except where otherwise indicated.

5-11. INSTALLING MISCELLANEOUS PARTS TO THE OUTER CIRCUMFERENCE OF THE COMPRESSOR FRONT FRAME.

a. Install static pressure tap boss (23) and gasket to front frame of J47-27 engines and secure using 2 screws and washers. Refer to Section VIII, Reference No. 132 for torque value and lockwire. On J47-23, -25 and -25A engines, install cover plate (23A) and secure using 2 screws and washers. Refer to Section VIII, Reference No. 132 for torque value. Lockwire.

b. Install elbow (18) with jam nut and O-ring seal to the static pressure tap boss. Refer to Section VIII, table XLVIII for torque value.

c. Install 3 flexible drive shaft brackets (15) to the front frame and secure using one bolt and washer each. Refer to Section VIII, Reference No. 104 for torque value. Lockwire.

d. Install 4 air vent screens (12) and secure using 4 screws each. Refer to Section VIII, Reference No. 130 for torque value. Lockwire single strand.

e. Install 2 balance-chamber airport covers (14) and secure with 2 screws and washers each. Refer to Section VIII, Reference No. 131 for torque value. Lockwire.

f. Install the vent cover (24) and gasket; secure with 4 screws and washers. Refer to Section VIII, Reference No. 130 for torque value. Lockwire single strand.

g. Install 3 anti-icing swivel connector elbows (13) and O-ring seal. Refer to Section VIII, table XLVIII for torque value.

h. Install double tee oil drain connector (17) and gasket to the front frame using 6 bolts and washers. Refer to Section VIII, Reference No. 133 for torque value. Lockwire in groups of 3.

i. Install the union (16) and O-ring seal to the boss on left side of double tee oil drain connector (17). For engines not equipped with auxiliary drive mount assemblies, install bleeder plug (16A). Refer to Section VIII, table XLVIII for torque value. Lockwire.

j. Install the connector elbow (19) with jam nut and O-ring seal; and union (20) with gasket to the left side of double tee oil drain connector. Refer to Section VIII, table XLVIII for torque value.

k. Install 2 bleeder plugs (21, 22) and O-ring seals to the right side of double tee oil drain connector. Refer to Section VIII, table XLVIII for torque value. Lockwire plug (21, 22) to plug (16A).

5-12. INSTALLING MISCELLANEOUS PARTS TO THE COMPRESSOR FRONT FRAME COVER.

Note

Throughout this paragraph numbers in parentheses refer to figure 5-2.

a. Install the bushing reducer (11) and O-ring seal to cover. Refer to Section VIII, table XLVIII for torque value.

b. Install the union (5) and gasket to cover. Refer to Section VIII, table XLVIII for torque value.

c. Install the scavenge pump outlet connector elbow (6) and O-ring seal to cover. Refer to Section VIII, table XLVIII for torque value.

d. Install "Y" drain connector (8) and O-ring seal on cover of J47-27 engines, or union and gasket (8A) for J47-23, -25 and -25A engines. Refer to Section VIII, table XLVIII for torque value.

e. Install the auxiliary gear case lube supply union (9) and O-ring seal for engines using auxiliary drive mount assemblies, or install bleeder plug (9A) and O-ring seal for engines not equipped with auxiliary drive mount assemblies. Torque union or bleeder plug. Refer to Section VIII, table XLVIII for torque value. Lockwire bleeder plug.

f. Install 4 inlet island fairing brackets (3) and secure using 2 bolts and washers each. Refer to Section VIII, Reference No. 134 for torque value. Lockwire.

g. Install anti-icing tubes to struts and tap gently with plastic mallet until firmly seated. Install the seal over the tube in each strut. Install a duct (1) to each strut by inserting locating pin into opening in front frame and secure, using counter-sunk screw. Refer to Section VIII, Reference No. 135 for torque value.

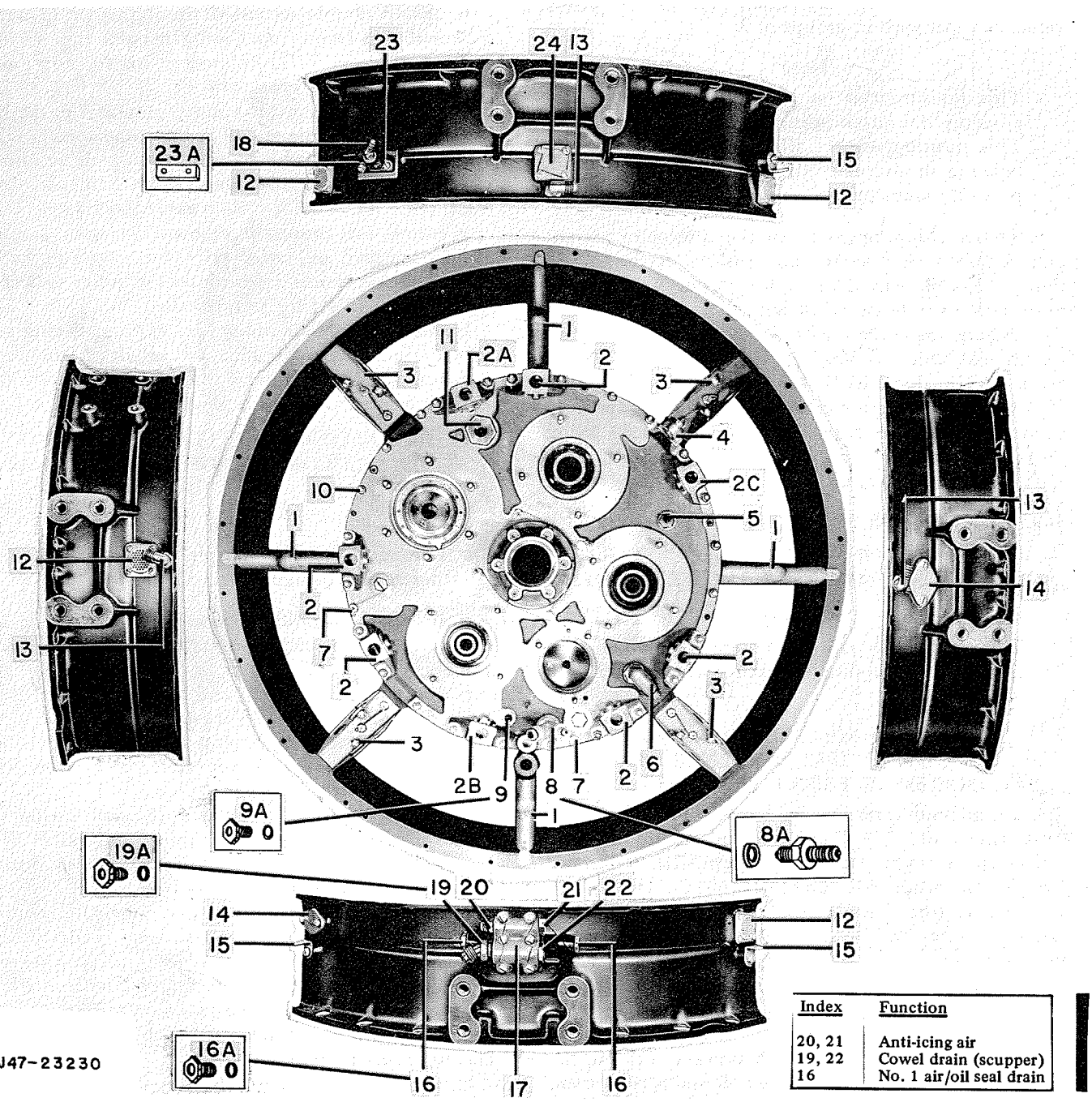
5–13. ASSEMBLY OF ACCESSORIES AND COMPONENTS TO THE COMPRESSOR FRONT FRAME.

5–14. BUILDUP OF COMPRESSOR FRONT FRAME ACCESSORIES.

a. Starter-generator mounting pad assembly.

(1) Assemble the outer cowling to the mounting pad and secure with 3 screws and washers. Refer to Section VIII, Reference No. 83 for torque value.

(2) Assemble the Marmon clamp to the mounting pad in the recess provided.



Index	Function
20, 21	Anti-icing air
19, 22	Cowel drain (scupper)
16	No. 1 air/oil seal drain

Figure 5–2. Front, Left, Right and Bottom View of Compressor Front Frame

Note

Coat all fittings with anti-seize compound, Specification MIL-L-25681. All bulkhead and universal fittings must be positioned and torqued after assembly of the accessory to the engine, for proper positioning.

b. Main lube pump. (See figure 5-3.)

(1) Install the pressure relief valve to lube oil pump using jam nut and O-ring seal. Refer to Section VIII, table XLVIII for torque value.

(2) Install the tachometer-generator to lube oil pump, using O-ring seal, 4 nuts and washers. Refer to Section VIII, Reference No. 85 for torque value.

(3) Install the inlet connector elbow to lube oil pump, using 4 bolts and washers and one O-ring seal. Refer to Section VIII, Reference No. 92 for torque value. Lockwire.

c. High-pressure fuel filter. (See figure 5-4.)

(1) On the J47-27 engine install two 45 degree elbows, with jam nuts and O-ring seals, to the fuel filter. Position and torque. Refer to Section VIII, table XLVIII for torque value.

Note

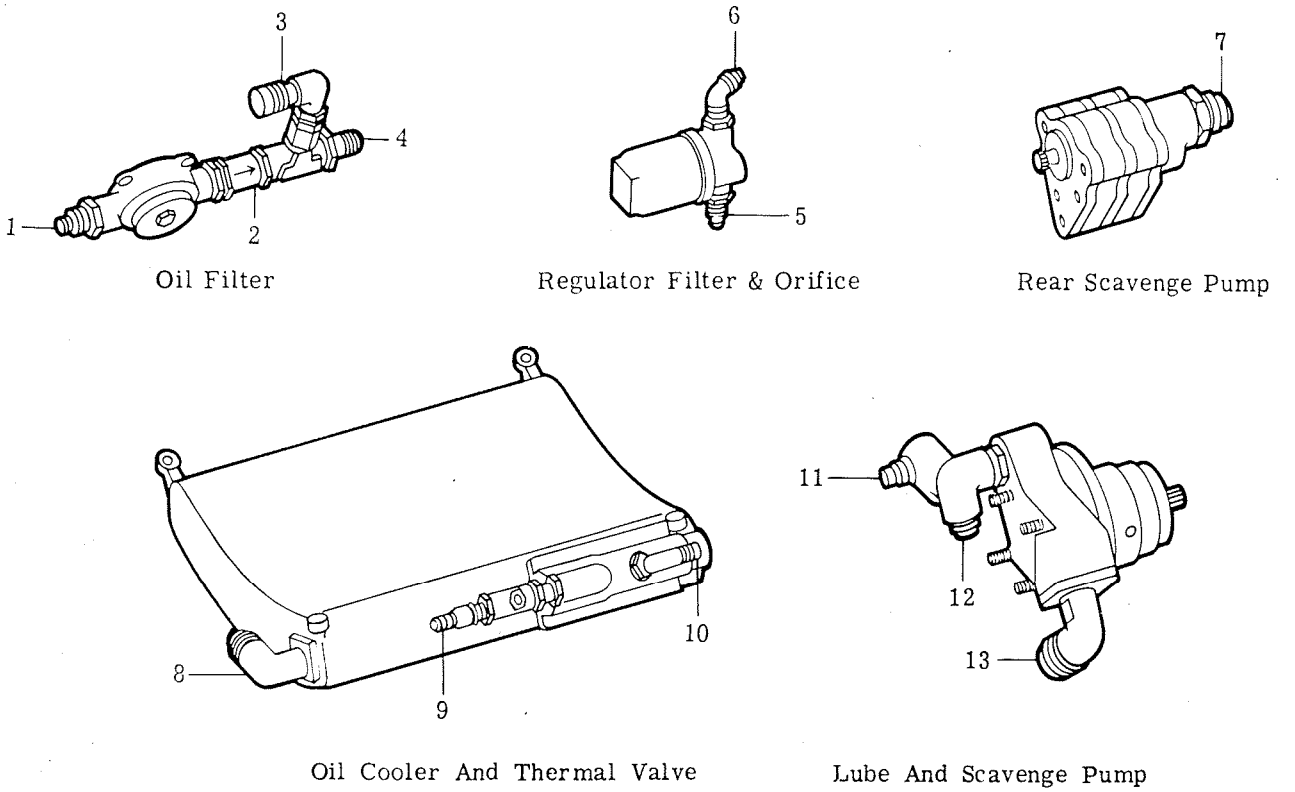
On the J47-23, -25 and -25A engine, install one 45 degree elbow, with jam nut and O-ring seal; and one plug with O-ring seal, to the fuel filter. Refer to Section VIII, table XLVIII for torque value.

(2) Install line to the fixed nipple on the fuel filter. Refer to Section VIII, Table XLI for torque value.

d. Fuel control valve. (See figure 5-4.)

(1) Install one connector to the fuel inlet port on the control valve, using one O-ring and 4 bolts and washers. Refer to Section VIII, Reference No. 90 for torque value.

(2) Install hose assembly (fuel filter to fuel control valve) to the control valve connector. Refer to Section VIII, Table XLI for torque value.

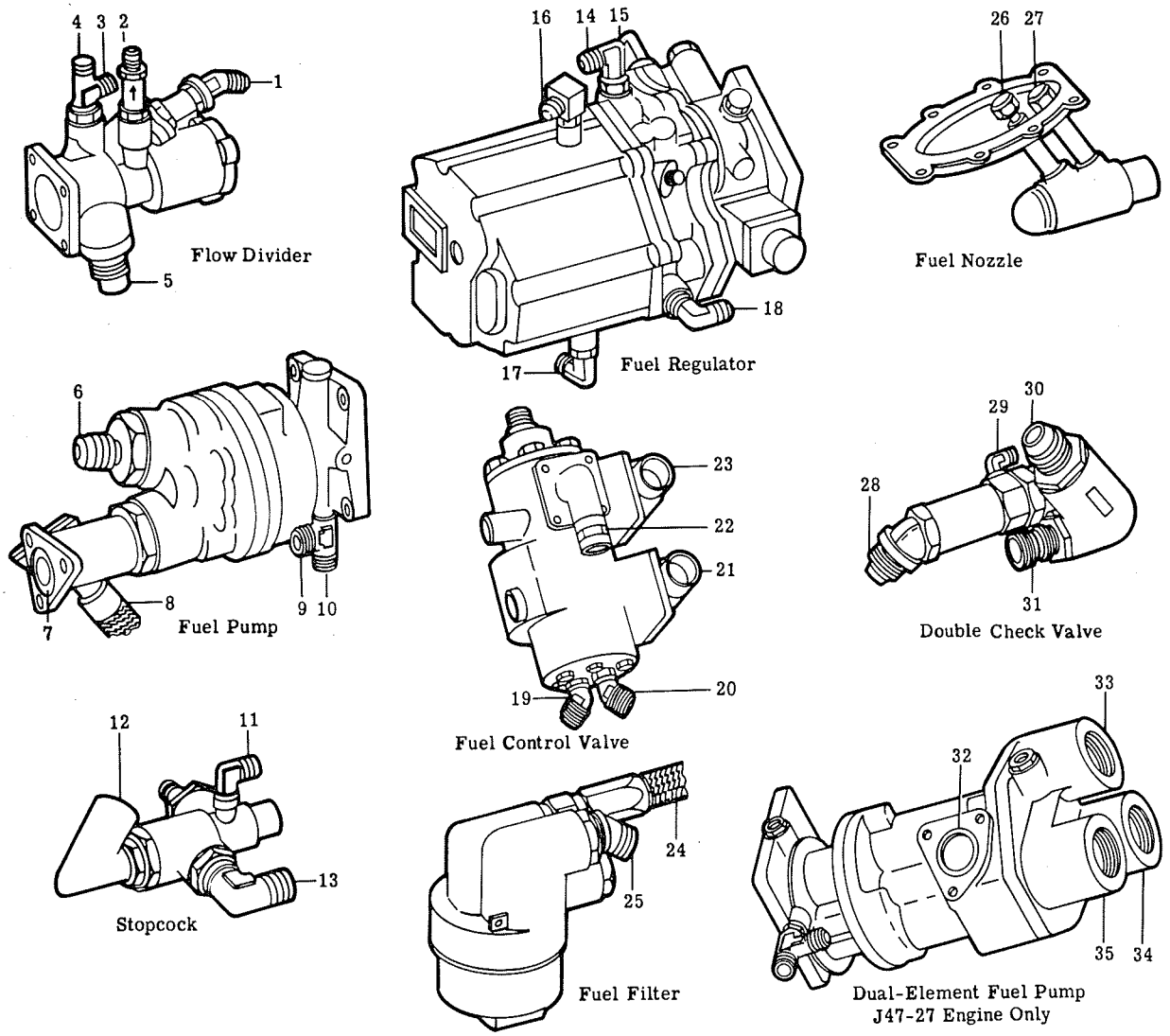


1. Supply Oil In from No. 3 Island
2. Oil Check Valve
3. Supply Oil Pressure Tap
4. Supply Oil to Compressor Rear Frame
5. Supply Oil In from Front Frame Gearcase
6. Supply Oil to Regulator
7. Scavenge Oil In from Turbine Frame Sump
8. Fuel In from No. 2 Island
9. Scavenge Oil Out
10. Scavenge Oil In
11. Supply By-pass Oil Relief Valve to Front Frame Gearcase
12. Supply Oil Out to No. 3 Island and Oil Filter
13. Oil In from No. 2 Island

Figure 5-3. Lube System Components for J47-23, -25, -25A and -27 Engines

(3) Install one orifice elbow to the variable control oil inlet port of the control valve using one O-ring and jam nut. Refer to Section VIII, Table XLVIII for torque value.

(4) Install one elbow to the variable control oil leakage return port of the fuel control valve using O-ring and jam nut. Refer to Section VIII, Table XLVIII for torque value.



1. Overboard Drain
2. Fuel Return Connector to No. 3 Island
3. Small Slot Pressure Tap
4. Connector to Small Slot Manifold
5. Connector to Large Slot Manifold
6. Fuel Pump Discharge to Fuel Filter
7. Fuel By-pass from Fuel Control Valve
8. Main Fuel Supply from No. 3 Island
9. Drain Connector from Stopcock
10. Drain Connector to No. 3 Island
11. Drain Connector to Fuel Pump Drain Tee
12. Fuel In
13. Fuel Out to No. 2 Island
14. Oil In from Regulator Filter and Orifice
15. Variable Control Oil to Fuel Control Valve (P/N AN833–4D on J47–25 and J47–25A; P/N 414B175 on J47–27)
16. Case Oil to Front Frame Gearcase
17. Variable Control Oil Leakage Return from Fuel Control Valve
18. Compressor Discharge Sensing from No. 4 Island
19. Variable Control Oil Pressure from Fuel Regulator
20. Variable Control Oil Leakage Return to Regulator
21. Fuel By-pass
22. Fuel Pump Discharge In from Fuel Filter
23. Fuel Out
24. Fuel In from Fuel Pump Discharge
25. Fuel Out to Inlet of Fuel Control Valve
26. Small Slot
27. Large Slot
28. Emergency Fuel In to Check and Restrictor Valve
29. Emergency Fuel Pressure Sensing Elbow
30. Main Fuel In to Double Check Valve
31. Fuel In to Stopcock
32. Fuel in from No. 3 Island
33. Pump Discharge Port for Lower Element Pump
34. Pump Discharge Port for Upper Element Pump
35. Fuel By-pass Port

Figure 5–4. Fuel System Components for J47–23, –25, –25A and –27 Engines

(5) Install connector (control valve to fuel pump by-pass) using seal, 4 bolts and washers. Refer to Section VIII, Reference No. 90 for torque value.

(6) On J47–23, –25 and –25A engines, install one connector and O-ring on the fuel out port of the fuel control valve. Secure with 4 bolts and washers. Refer to Section VIII, Reference No. 90 for torque value.

e. Regulator filter and orifice (See figure 5–3).

(1) Install mounting bracket, using 2 bolts and washers. Refer to Section VIII, Reference No. 74 for torque value. Lockwire.

Note

The inlet port must be on mounting side of bracket.

(2) Install two 45-degree elbows with O-ring seals and jam nuts.

f. Main fuel pump, J47–23, –25 and –25A engines. (See figure 5–4.)

(1) Install reducer with O-ring seal to the pump discharge. Refer to Section VIII, Table XLVIII for torque value.

(2) Install connector, with jam nut and O-ring seal, and thread in finger-tight. Refer to Section VIII, Table XLVIII for torque value when properly positioned.

(3) Install drain tee to the mounting base of the pump. Tighten until properly positioned (parallel to mounting pad base).

g. Dual fuel pump, J47–27 engines only. (See figure 5–4.)

(1) Install connector fitting to the fuel return port, using jam nut and O-ring seal. Refer to Section VIII, Table XLVIII for torque value.

(2) Install the union to the upper pump element pressure outlet port, using jam nut and O-ring seal. (Refer to figure 5–4, "34" for correct outlet port and Section VIII, Table XLVIII for torque value.)

(3) Install 90-degree elbow to the lower element fuel pressure outlet port, using jam nut and O-ring seal. (Refer to figure 5–4, "33" for correct outlet port and Section VII, Table XLVIII for torque value.)

h. Stopcock. (See figure 5–4.)

(1) Install 90-degree elbow to stopcock outlet, using jam nut and O-ring seal. Refer to Section VIII, Table XLVIII for torque value.

(2) Install the stopcock drain elbow with jam nut and O-ring seal. Refer to Section VIII, Table XLVIII for torque value.

(3) Install a union to double check valve using O-ring seal. Refer to Section VIII, Table XLVIII for torque value.

(4) On the J47–27 only, install double check valve to stopcock, using jam nut and O-ring seal. Refer to Section VIII, Table XLVIII for torque value.

i. Main fuel regulator, (See figure 5–4.)

(1) Install the compressor discharge sensing elbow with jam nut and O-ring seal, to the main fuel regulator sensing port.

(2) Install variable control (oil-in) leakage return elbow, with a jam nut and O-ring seal, to the main fuel regulator oil-in port.

(3) Install the oil-return elbow, with jam nut and O-ring seal, to the main fuel regulator oil-return port.

(4) Install the variable cotnrol (oil-out) elbow, with jam nut and O-ring seal, to the main fuel regulator oil-out port.

CAUTION

Assure that special orificed elbow, P/N 414B175, is used on J47–27 engines.

(5) Install the oil inlet elbow, with a jam nut and O-ring seal, to the main fuel regulator oil inlet port (90-degree elbow machined in accordance with T.O. 2J–J47–206).

(6) Install stopcock assembly to the main fuel regulator, using 2 bolts and washers. Refer to Section VIII, reference No. 88 for torque value. Lockwire.

j. Check and restrictor valve, J47–27 engines only. (See figure 5–4.)

(1) Install emergency fuel pressure sensing elbow, using jam nut and O-ring seal. Refer to Section VIII, Table XLVIII for torque value.

(2) Install valve to double check valve elbow, using jam nut and O-ring seal. Refer to Section VIII, Table XLVIII for torque value.

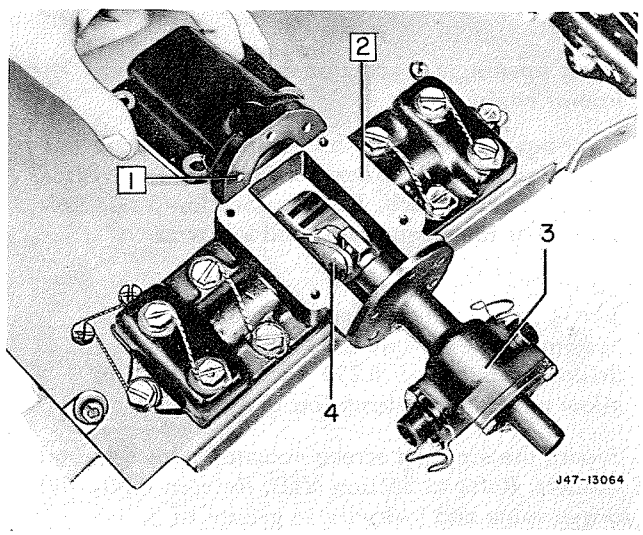
5–15. BUILDUP OF THE AIR INLET SECTORS.

Note

On some engines air inlet screens will not be incorporated. The following steps are to be used when applicable.

a. Place one sector on a suitable bench.

b. Install 2 inlet screen actuator housings (2, figure 5–5) and housing gaskets to sector. Secure with 6 bolts and washers. Refer to Section VIII, reference No. 102 for torque value.



1. Outer Housing
2. Inner Housing
3. Screen Actuator Assembly
4. Inlet Screen Pin

Figure 5–5. Installing Screen Actuator Outer Housing

Note

On sector assemblies provided with bumper mounting holes, make certain rubber bumpers are installed.

c. Install bearing and shim (5, figure 5–6) to right side of each housing. Secure with 2 bolts and washers. Refer to Section VIII, Reference No. 102 for torque value, and lockwire.

d. Install spacer to each trunnion on screen cowl.

e. Install bearing (1, figure 5–6) to the left side of each screen assembly; install screen to sector, using shim under each bearing. Secure bearing with 2 bolts and washers each. Refer to Section VIII, Reference No. 102 for torque value.

Note

Check screen assembly for side-play. If more than 0.015 side play is found, re-shim to 0.015 maximum.

CAUTION

A clearance of 0.080 to 0.250 must be maintained between screens. It may be necessary to install new spacers or to shift old spacers to obtain this clearance.

f. Install one large inlet duct, (4, figure 5–6) to each sector. Secure with 2 screws and washers. Refer to Section VIII, Reference No. 105 for torque value.

g. Install one left and one right inlet duct baffle to each sector. Secure with 2 screws and washers each. Refer to Section VIII, Reference No. 105 for torque value.

h. Install an air inlet screen actuator to each housing, making certain the actuator hook-arm engages with screen clevis pin.

Note

Hook opening on actuator arm faces centerline of engine.

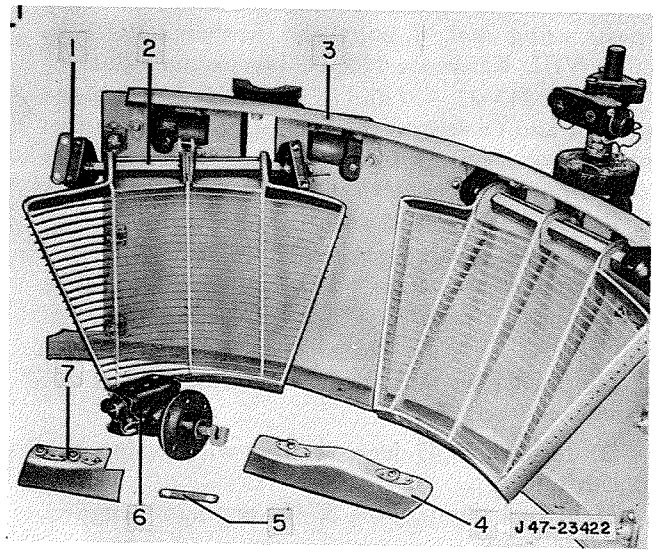
i. If two-piece housings are installed, install one outer housing to each inner housing. Secure with 4 screws and washers each. Refer to Section VIII, Reference No. 101 for torque value and lockwire.

Note

The 2 lower outer housings installed to the bottom of the compressor front frame have a drilled passage of 0.250 inch diameter to allow moisture condensation to escape.

j. Secure the air inlet screen actuator with 6 screws and washers. Refer to Section VIII, Reference No. 100 for torque value and lockwire in groups of 3.

k. Remove the sector assembly from stand, and with screens in full-open position, check for sector-to-bearing clearance. A clearance of 0.080 to 0.250 must be maintained.



1. Bearing Housing Assembly
2. Inlet Screen Sector Assembly
3. Inner Housing
4. Air Baffle
5. Air Baffle
6. Screen Actuator Assembly
7. Air Baffle

Figure 5–6. Air Guide Quadrant Assembly

Note

Steps "l" and "m" below apply to J47–GE–23, –25, and –25A engines only.

l. Install one air inlet cowl guide to the No. 1, 2, 3, 7 and No. 8 screen housings. Secure with 2 bolts and washers each. Refer to Section VIII, Reference No. 96 for torque value.

m. Install the accumulator cowl guide to the No. 6 housing as follows:

(1) Install accumulator tube to the guide cow Secure with clamp, and torque. Refer to Section VIII, Reference No. 98 for torque value.

(2) Install union and O-ring seal to the accumulator tube. Refer to Section VIII, table XLVIII for torque value.

(3) Install the air inlet cowl guide to the No. 6 screen housing and secure with 2 bolts and washers. Refer to Section VIII, Reference No. 96 for torque value.

5–16. BUILD UP OF THE ISLANDS.

a. No. 1 island build up, J47–27 engines. (See figure 5–7.)

(1) Install the No. 1 island cover in suitable fixture.

(2) Install connector to hydraulic power control suction fitting port (1) at an angle of 60 degrees from the horizontal centerline of the island cover. Use spacer on each side of island cover, with the thin portion of the upper spacer to the rear of cover, and the thin portion of lower spacer to the front of cover. Install jam nut and torque. Refer to Section VIII, table XLVI for torque value.

(3) Install housing and cable to island cover. Secure with 4 bolts and washers. Refer to Section VIII, table XL for torque value.

(4) Install the starter-generator terminal block. Secure with 3 screws and washers. Refer to Section VIII, table XL for torque value.

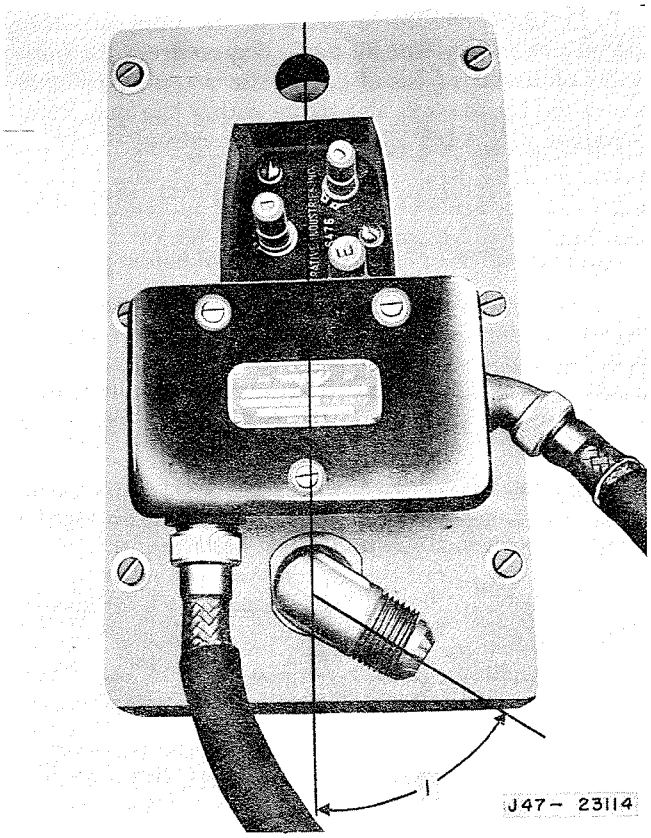
b. No. 2 island buildup (J47-27 engine). (See figure 5-8.)

(1) Install the No. 2 island cover in suitable stand.

(2) Install 90-degree elbow to hydraulic drain port (6) at an angle of 14 to 16 degrees from the horizontal centerline of the cover. Use a washer on each side of the cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.

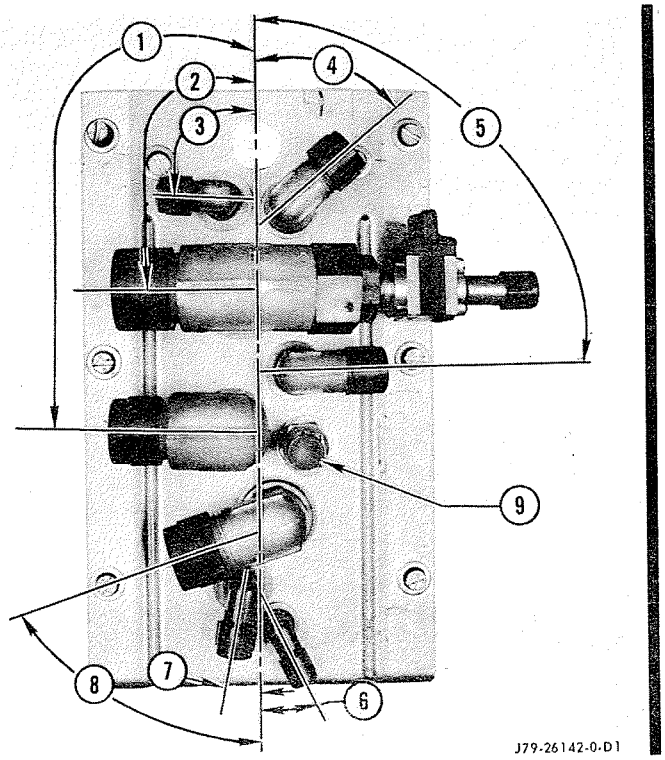
(3) Install 90-degree elbow to power control case drain port (7) at an angle of 9 to 11 degrees from the horizontal centerline of the cover. Use a washer on each side of island cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.

(4) Install 90-degree elbow to fuel outlet to oil-cooler port (8) at an angle of 74 to 76 degrees from the horizontal centerline of the island cover. Use a washer on each side of cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.



1. Hydraulic Power Control Suction Fitting

Figure 5-7. No. 1 Island Build-up, J47-27



1. Utility Hydraulic Suction
2. Main Oil Inlet
3. Hydraulic Utility Case Drain
4. Normal Hydraulic Pressure
5. Utility Hydraulic Elbow
6. Hydraulic Drain
7. Power Control Case Drain
8. Fuel Outlet to Oil Cooler
9. Regulator Priming Check Valve

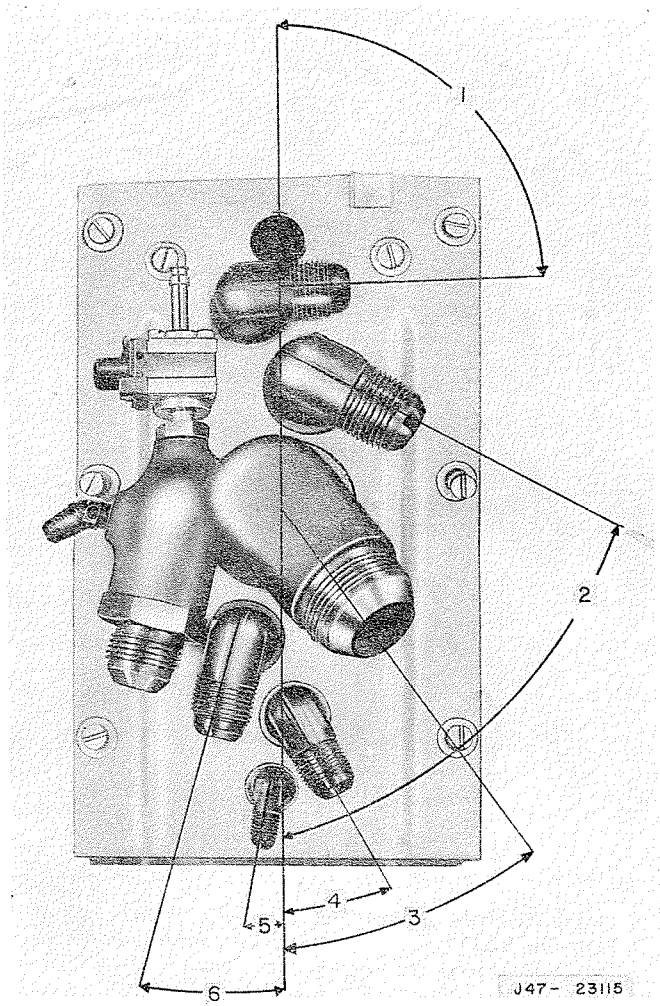
Figure 5-8. No. 2 Island Build-up, J47-27

(5) Install connector elbow to the utility hydraulic suction port (1) at an angle of 83 to 85 degrees from the horizontal centerline of the island cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.

(6) Install connector to the utility hydraulic pressure port (5) at an angle of 89 to 91 degrees from the horizontal centerline of island cover. Use a washer on each side of the island and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.

(7) Install connector to the main oil inlet port (2) at angle of 89 to 91 degrees from the horizontal centerline of the island cover. Use a washer on each side of the island cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.

(8) Install 90-degree elbow to the hydraulic utility case drain port (3) at an angle of 89 to 91 degrees from the horizontal centerline of the island cover. Use a washer on each side of the island cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.



1. Nose Anti-Icing
2. Emergency Fuel Outlet
3. Main Fuel Inlet
4. Scavenge Oil Outlet
5. Fuel Overboard Drain
6. Oil Filter Elbow

Figure 5-9. No. 3 Island Build-up, J47-27

(9) Install 90-degree elbow to the hydraulic pressure port (4) at an angle of 51 to 53 degrees from the horizontal centerline of the island cover. Use a washer on each side of the island cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.

(10) Install priming check valve (9), P/N P616, in the priming port. Be sure that the index pins of the valve are properly assembled into the island. Install washer, P/N 414B623P1, on the outside of the island and secure with a jam nut. Refer to Section VIII, Table XLVI for torque value.

c. No. 3 island build-up (J47-27 engines). (See figure 5-9.)

(1) Install the No. 3 island cover in a holding fixture.

(2) Install 90-degree elbow to fuel overboard drain port (5) at an angle of 5 to 7 degrees from the horizontal centerline of island cover. Use a washer on each side of the island cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.

(3) Install 90-degree elbow to scavenge oil-outlet port (4) at an angle of 24 to 26 degrees from the horizontal centerline of the island cover. Use a washer to each side of the island cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.

(4) Install 90-degree elbow to the oil filter port (6) at an angle of 14 to 16 degrees from the horizontal centerline of island cover. Use a washer on each side of the island cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.

(5) Install connector to the main fuel inlet port (3) at an angle of 35 to 37 degrees from the horizontal centerline of island cover. Use a washer on each side of the island cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.

(6) Install 90-degree elbow to the emergency fuel outlet at an angle of 53 to 57 degrees from the horizontal centerline of island cover. Use a washer on each side of the island cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.

(7) Install 90-degree elbow to the nose anti-icing port (1) at an angle of 89 to 91 degrees from the horizontal centerline of island cover. Use a washer on each side of the island cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.

d. No. 4 island build-up (J47-27 engines). (See figure 5-10.)

(1) Install the No. 4 island cover in holding fixture.

(2) Install 90-degree elbow to the emergency fuel pressure sensing port (2) at an angle of 30 to 32 degrees from the horizontal centerline of island cover. Use a washer on each side of the island cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.

(3) Install 90-degree elbow to the twelfth stage pressure-sensing port (1) at an angle of 30 to 32 degrees from the horizontal centerline of island cover. Use a washer on each side of the island cover and secure with a jam nut. Refer to Section VIII, table XLVI for torque value.

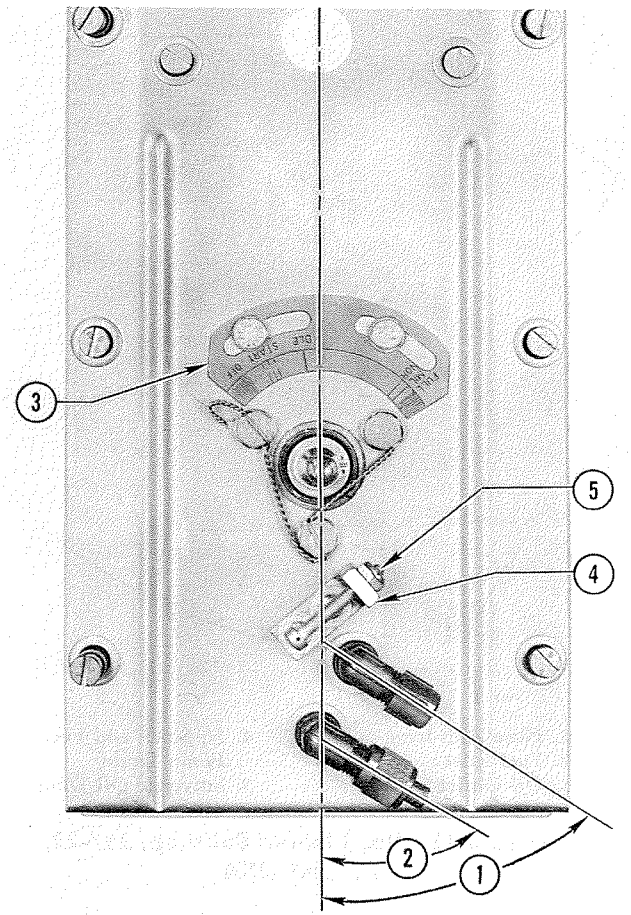
(4) Install the escutcheon plate (3) to the island cover. Secure with 2 bolts and washers. Refer to Section VIII, table XL for torque value.

(5) Install the control linkage high-speed stop (4); secure with 2 bolts, nuts, and washers. Refer to Section VIII, table XL for torque value. Lockwire.

CAUTION

To avoid possible engine overspeed, make sure high speed adjustment is secured using nut, MS21042-3, located as shown in figure 5-10.

(6) Install screw and locknut (6) in the high-speed stop. Make sure the screw is installed with the slotted head rearward and the locknut is positioned on the forward side of the high-speed stop.



1. Compressor Discharge Pressure Elbow
2. Emergency Fuel Pressure Sensing Elbow
3. Escutcheon Plate
4. Control Linkage High Speed Stop
5. Screw and Locknut, High Speed Stop

Figure 5-10. No. 4 Island Build-up, J47-27

e. No. 1 island build-up (J47-23, -25 and -25A engines). (See figure 5-11.)

(1) Install the No. 1 island cover in a holding fixture.

(2) Install 90-degree elbow to the hydraulic brake oil-inlet port (1) at an angle of 89 to 91 degrees from the horizontal centerline of the island cover. Use a washer on each side of island cover, and install jam nut. Refer to Section VIII, table XLVI for torque value.

f. No. 2 island build-up (J47-23, -25 and -25A engines). (See figure 5-12.)

(1) Install the No. 2 island cover in a holding fixture.

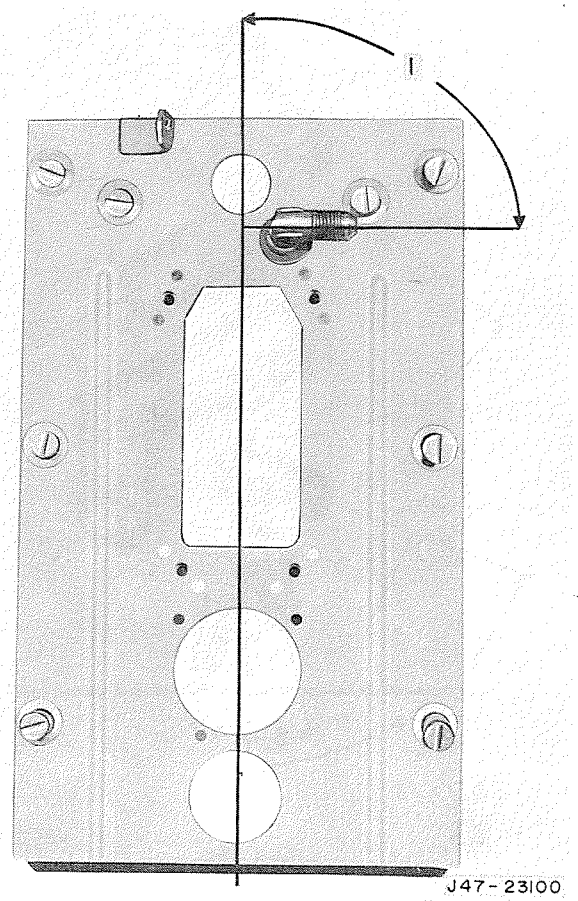
(2) Install 90-degree elbow to the hydraulic pump drain port (4) at an angle of 8 to 9 degrees from the horizontal centerline of the island cover. Use a washer on each side of island cover and install jam nut. Refer to Section VIII, table XLVI for torque value.

(3) Install 90-degree elbow to the hydraulic pump by-pass port (5) at an angle of 19 to 21 degrees from the horizontal centerline of the island cover. Use a washer on each side of island cover and install jam nut. Refer to Section VIII, table XLVI for torque value.

(4) Install 90-degree elbow to the hydraulic pressure port (6) at an angle of 69 to 71 degrees from the horizontal centerline of the island cover. Use a washer on each side of island cover and install jam nut. Refer to Section VIII, table XLVI for torque value.

(5) Install a connector to the hydraulic suction port (3) at an angle of 59 to 61 degrees from the horizontal centerline of the island cover. Use a washer on each side of island cover and install jam nut. Refer to Section VIII, table XLVI for torque value.

(6) Install 90-degree elbow to the fuel inlet port (2) at an angle of 69 to 71 degrees from the horizontal



1. Hydraulic Brake Oil Inlet

Figure 5-11. No. 1 Island Build-up, J47-23, -25 and -25A

centerline of the island cover. Use a washer on each side of island cover and install jam nut. Refer to Section VIII, table XLVI for torque value.

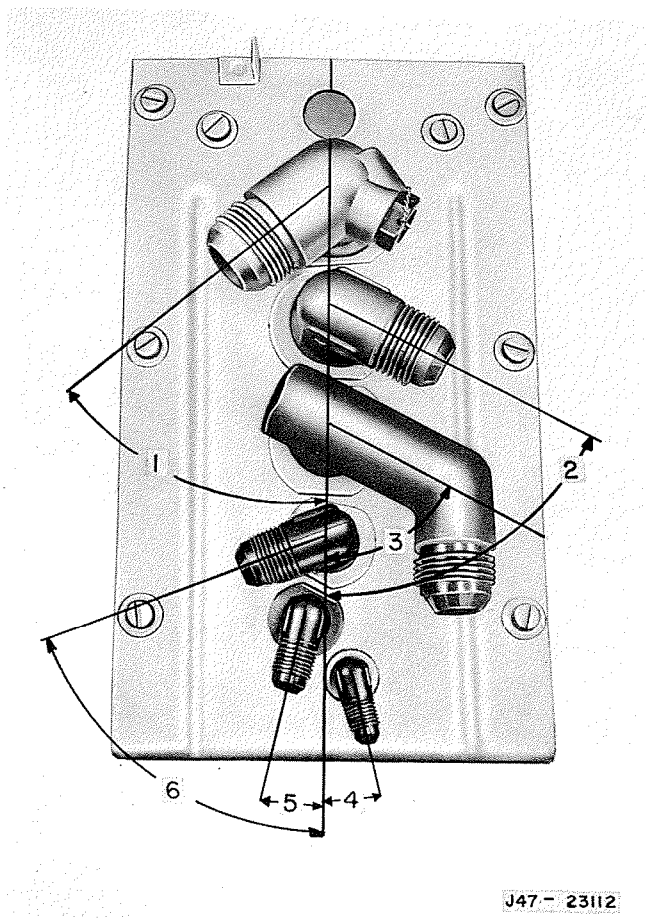
(7) Install connector to the oil-inlet port (1) at an angle of 49 to 51 degrees from the horizontal centerline of island cover. Use a washer on each side of the island cover and install jam nut. Refer to Section VIII, table XLVI for torque value.

g. No. 3 island build-up (J47-23, -25 and -25A engines). (See figure 5-13.)

(1) Install the No. 3 island in holding fixture.

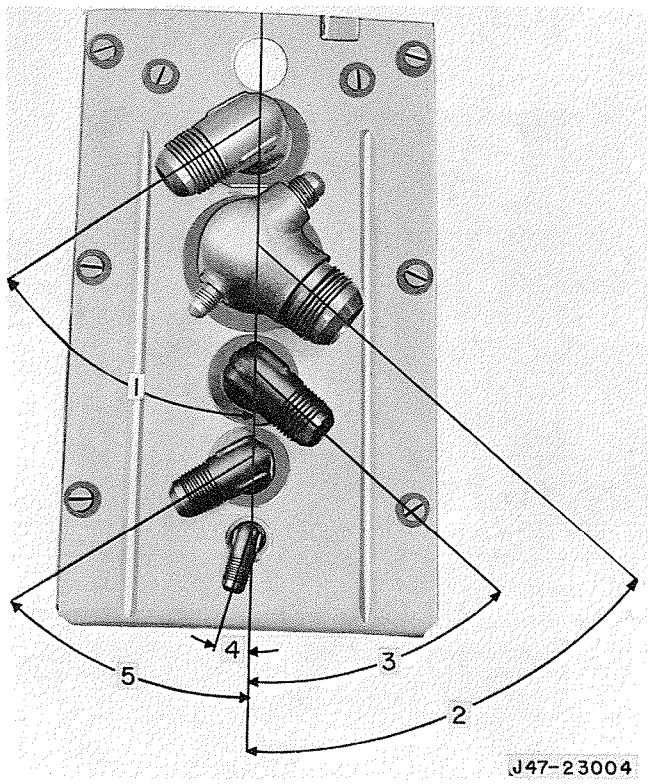
(2) Install 90-degree elbow to the stopcock and fuel pump drain port (4) at an angle of 24 to 26 degrees from the horizontal centerline of the island cover. Use a washer on each side of island cover and install jam nut. Refer to Section VIII, table XLVI for torque value.

(3) Install 90-degree elbow to the scavenge oil port (5) at an angle of 59 to 61 degrees from the horizontal centerline of the island cover. Use a washer on each side



1. Oil Inlet
2. Fuel Outlet
3. Hydraulic Suction Elbow
4. Hydraulic Pump Drain
5. Hydraulic Pump By-pass
6. Hydraulic Pressure Elbow

Figure 5-12. No. 2 Island Build-up, J47-23, -25, and -25A



1. Nose Anti-Icing
2. Fuel Inlet
3. Oil Outlet
4. Stopcock and Fuel Pump Drain
5. Scavenge Oil Drain

Figure 5-13. No. 3 Island Build-up, J47-23, -25, and -25A

of island cover and install jam nut. Refer to Section VIII, table XLVI for torque value.

(4) Install 90-degree elbow to oil outlet port (3) at an angle of 44 to 46 degrees from the horizontal centerline of the island cover. Use a washer on each side of the island cover and install jam nut. Refer to Section VIII, table XLVI for torque value.

(5) Install connector to the fuel inlet port (2) at an angle of 49 to 51 degrees from the horizontal centerline of island cover. Use a washer on each side of the island cover and install jam nut. Refer to Section VIII, table XLVI for torque value.

(6) Install 90-degree elbow to nose anti-icing port (1) at an angle of 59 to 61 degrees from the horizontal centerline of the island cover. Use a washer on each side of the island cover and install jam nut. Refer to Section VIII, table XLVI for torque value.

h. No. 4 island build-up (J47-23, -25 and -25A engines). (See figure 5-14.)

(1) Install the No. 4 island cover in holding fixture.

(2) Install 90-degree elbow to the compressor discharge pressure port (1) at an angle of 8 to 9 degrees from the horizontal centerline of the island cover. Use

a washer on each side of the island cover and install jam nut. Refer to Section VIII, table XLVI for torque value.

(3) Install the escutcheon plate (2) to the island cover. Secure with 2 bolts and washers. Refer to Section VIII, table XL for torque value.

(4) Install the control linkage high speed stop (3, figure 5-14) and secure with 2 bolts, washers and nuts. Refer to Section VIII, Table XL for torque value. Install the screw and locknut (5, figure 5-14) in the high speed stop. Make sure the screw is installed with the slotted head rearward and the locknut is positioned on the forward side of the high speed stop.

CAUTION

To avoid possible engine overspeed, make sure high speed adjustment is secured using nut, MS21042-3, located as shown in figure 5-14.

(5) Install a 90-degree elbow (4) and washers to the regulator priming port at an angle of 49 to 51 degrees from the centerline of the island cover. Secure with a washer and jam nut. Refer to Section VIII, table XLVI, for torque value.

5-17. INSTALLING ACCESSORIES AND COMPONENTS TO THE COMPRESSOR FRONT FRAME.

Note

Before installing accessories on the front frame lubricate the utilized female splines by filling all of the tooth spaces with lubricant. Use lubricant, Plastilube Moly No. 3, Federal Stock No. 9150-823-8045 or equivalent. Do not lubricate the lube pump drive spline due to its contact with gearbox oil and the possibility of oil contamination. Do not over-lubricate the starter and adapter splines to prevent lubricant from contacting the carbon seal and causing leaks.

CAUTION

Avoid contamination of engine oil with spline lubricant.

a. Assembly of accessories, J47-27 engines.

Note

For special tools, see Section II, group 1.

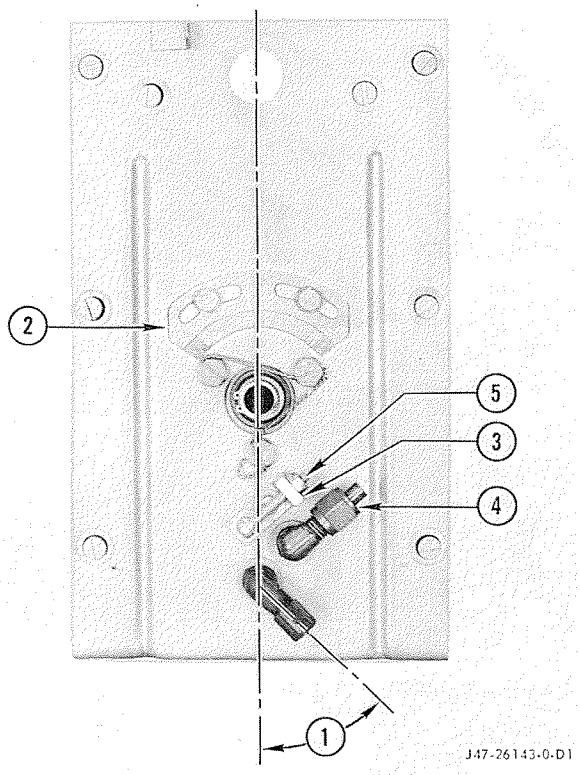
(1) Install front frame into assembly stand 1C817 using mounting brackets 1C810 and adapter brackets 1C619-59. (See figure 5-15.)

Note

See figure 5-23 for fuel and oil flow schematic.

Note

Index numbers for steps (2) through (5) are listed in figure 5-16.



1. Compressor Discharge Pressure Elbow
2. Escutcheon Plate
3. Control Linkage High Speed Stop
4. Regulator Priming Elbow
5. Screw and Locknut, High Speed Stop

Figure 5-14. No. 4 Island Build-up, J47-23, -25 and -25A

(2) Install cover plate (4) and gasket to the auxiliary gear mounting pad. Secure the cover plate using 4 nuts and washers. Refer to Section VIII, Reference No. 82 for torque value.

(3) Install the main fuel regulator assembly (1) and gasket to the front frame. Secure the regulator to the front frame using 4 nuts and washers. Refer to Section VIII, Reference No. 89 for torque value.

(4) Install the lube oil pump and the tachometer-generator assembly (2) to the front frame. Install 4 O-ring seals to the lube pump assembly. Secure the pump assembly to the front frame using 3 nuts and washers. Refer to Section VIII, Reference No. 86 for torque value.

(5) Install the starter-generator base assembly (3) and gasket to the front frame. Secure the base assembly using 6 nuts and washers. Refer to Section VIII, Reference No. 83 for torque value.

Note

Index number for steps (6) through (13) are listed in figure 5-17.

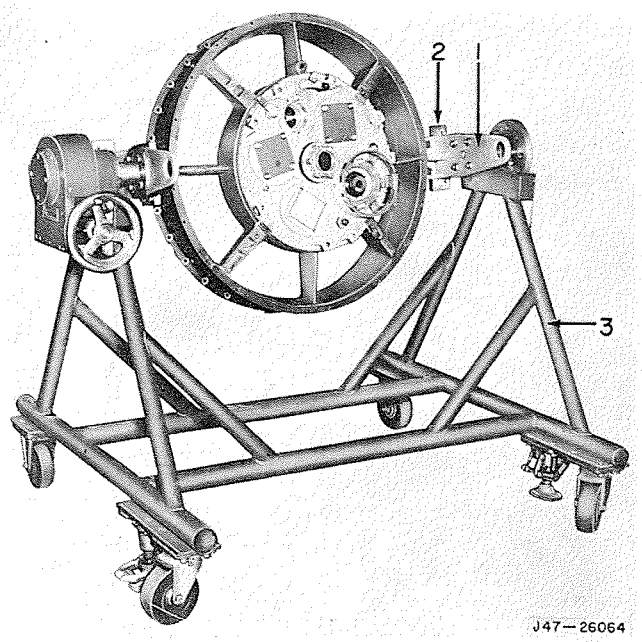
(6) Install the fuel pump assembly (1) and gasket to the front frame. Secure the fuel pump assembly using 4 nuts and washers. Refer to Section VIII, Reference No. 87 for torque value.

(7) Remove the inner bearing assembly and the support block from the front frame.

Note

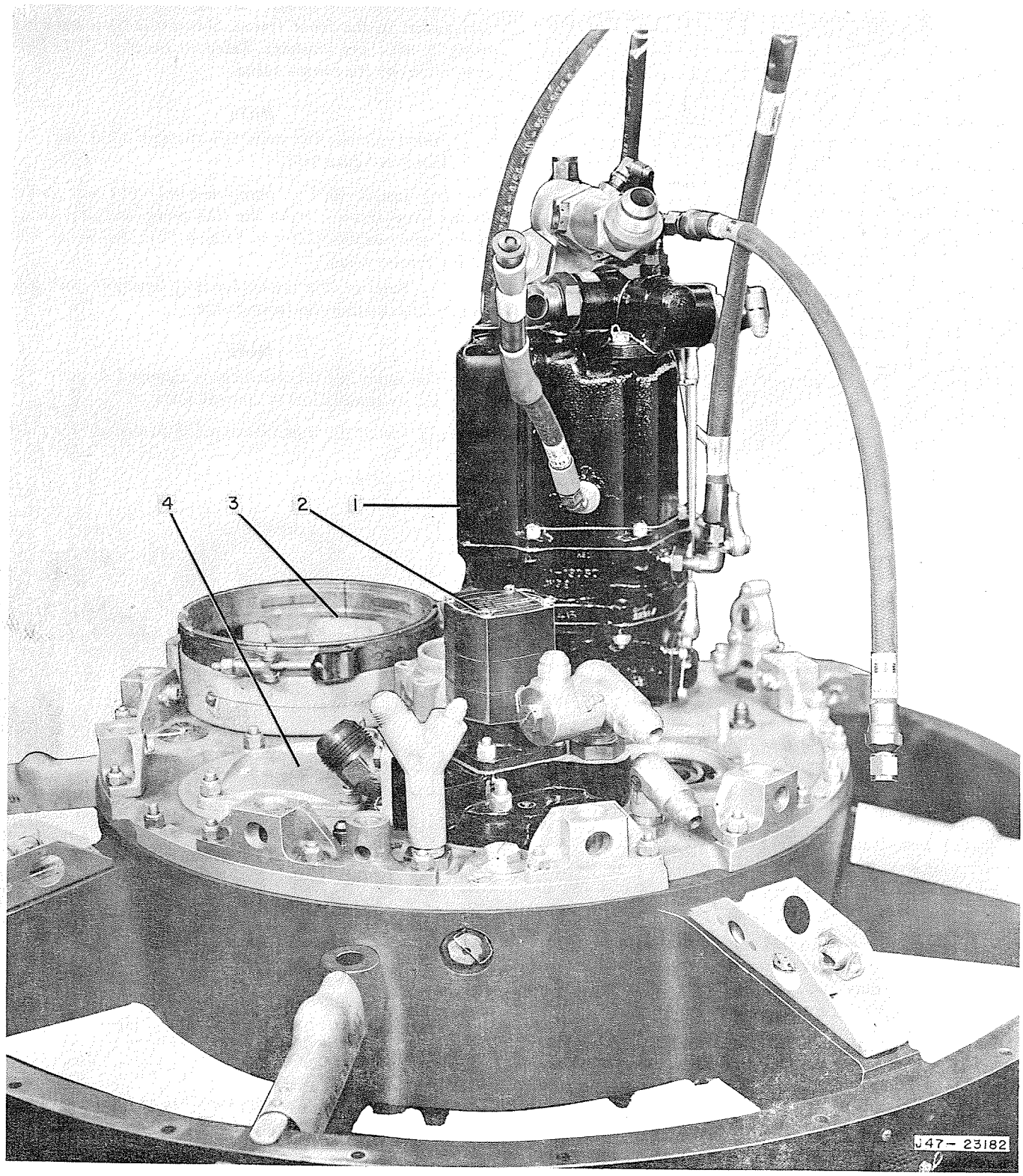
The inner bearing assembly is removed to permit its installation to control shaft.

(8) Install the inner bearing (2) to the control shaft (4).



1. Bracket, Front Frame Lifting, 1C810
2. Bracket, Front Frame, 1C619-59
3. Stand, 1C817

Figure 5-15. Compressor Front Frame in Stand 1C817



1. Main Fuel Regulator
2. Lube Pump and Tachometer Generator Assembly
3. Starter Generator Base
4. Auxiliary Shaftgear Cover Plate

Figure 5–16. Main Fuel Regulator, Lube and Scavenge Pump, Tachometer Generator Assemblies Installed, J47–27

(9) Install the clevis assembly (3) to the control shaft. Secure with one bolt, washer, and nut. Refer to Section VIII, Reference No. 116 for torque value.

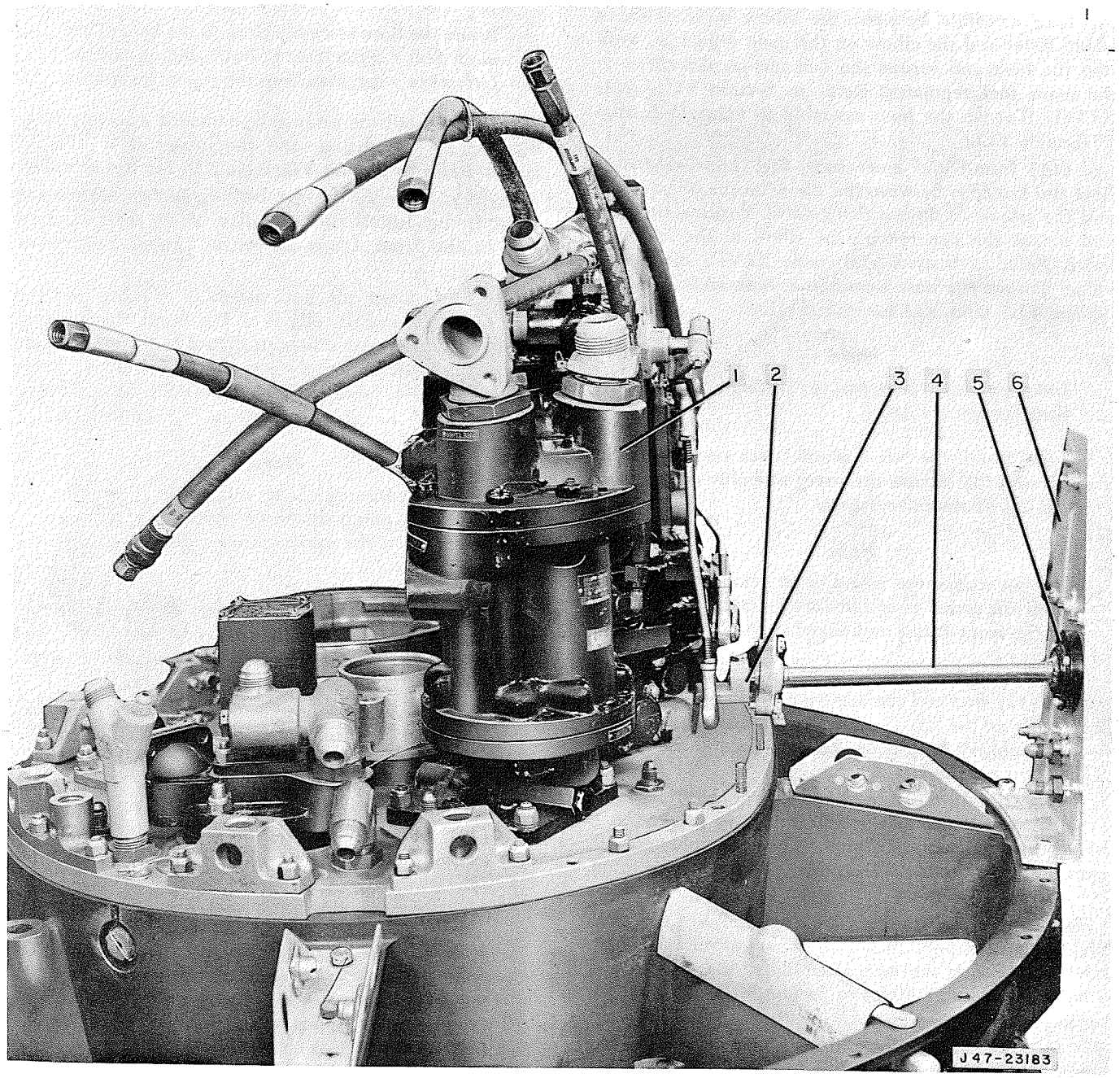
(10) Install the outer bearing assembly (5) to the control shaft.

(11) Install the control shaft assembly to the No. 4 island cover plate (6), and secure the outer bearing to the island cover-plate using 3 bolts and washers. Refer to Section VIII, Reference No. 111 for torque value.

(12) Install the No. 4 island cover assembly (6) to the front frame. Secure the cover assembly to the front frame flange with 2 bolts and washers, but do not torque the bolts.

Note

Do not torque the island cover retaining bolts until the sector assemblies are properly aligned to the front frame and the island cover assemblies.



1. Fuel Pump
2. Control Shaft Inner Bearing
3. Control Shaft Clevis
4. Control Shaft
5. Control Shaft Outer Bearing
6. No. 4 Island Cover

Figure 5–17. Installing Control Shaft and Fuel Pump, J47–27

(13) Install the inner bearing assembly (2) and the support block assembly to the front frame. Secure using 3 nuts and washers. Refer to Section VIII, Table XL for torque value.

Note

For complete information on assembling and adjusting of the control linkage refer to paragraph 5–17, step "b".

(14) Install the compressor discharge pressure-sensing hose assembly between the elbow on the No. 4 island cover and the elbow on the main regulator. Position the hose and torque the jam nut on the elbow at the main fuel regulator. Refer to Section VIII, table XLVIII. Torque the hose assembly to value in Section VIII, table VLI.

(15) Install the emergency fuel pressure-sensing hose and assembly between the elbow on the No. 4 island and the elbow on the restrictor valve. Position the hose and torque the jam nut on the elbow at the restrictor valve. Refer to Section VIII, table XLVIII for torque value. Torque the hose assembly at both ends. Refer to Section VIII, table XLI for torque value.

Note

Index numbers for steps (16) through (32) are listed in figure 5–18.

(16) Install the No. 3 island cover assembly to the front frame (9). Secure the cover assembly to the front frame using 2 bolts and washers.

Note

Do not torque the island cover retaining bolts until the sector assemblies are properly aligned to the front frame and island cover assemblies.

(17) Install the scavenge pump discharge hose assembly (12) between the scavenge discharge elbow and the fitting at the No. 3 island cover assembly. Torque hose assembly at both ends. Refer to Section VIII, table XLI for torque value.

(18) Install the lube oil discharge hose assembly (13) between the connector and the fitting on the No. 3 island cover assembly. Torque the hose assembly at both ends. Refer to Section VIII, table XLI for torque value.

(19) Install the fuel pump supply hose assembly (14) between the fitting at No. 3 island and the main fuel pump inlet port. Install an O-ring to the fuel pump inlet port. Secure the hose assembly to the pump using 3 bolts and washers. Refer to Section VIII, table XL for torque value.

(20) Install the nose anti-icing tube assembly to the elbow on the No. 3 island cover (16, figure 5–18). Refer to Section VIII, table XLI for torque value.

(21) Install the stopcock to flowmeter hose assembly (11) to the elbow on the stopcock. Torque the jam nut on the elbow. Refer to Section VIII, table XLVIII for torque value. Torque the hose assembly to value in Section VIII, table XLI.

(22) Install the check valve assembly (lube oil supply), with the arrow pointing in the direction of flow, and gasket to the upper position on the front frame cover. Refer to Section VIII, table XLVIII for torque value.

(23) Connect the lube oil supply hose assembly from the filter (1) to the check valve assembly. Refer to Section VIII, table XLI for torque value.

Note

Route the hose assembly close to the base of the main fuel regulator to prevent chafing and interference when installing the starter generator.

(24) Install the drain tube and hose assembly (10) between the tee fitting, and the fitting at the No. 3 island. Refer to Section VII, table XLI for torque value.

(25) Assemble the manifold assembly (2) to the front frame. Install slave auxiliary drive shaft housing (5) to the front frame to permit proper routing of fuel hoses.

(26) Connect the hose assembly (3) between the fuel manifold and the elbow on the lower element fuel pump discharge port. Refer to Figure 5–4, "33" for correct outlet port. Torque the jam nut on the elbow. Refer to Section VIII, table XLVIII for torque value. Torque hose assembly to values in Section VIII, table XLI.

Note

To make torquing of jam nut on the lower element fuel pump discharge port easier, remove fitting from the upper element fuel pump discharge port.

(27) Connect the hose assembly (7) from the fuel manifold assembly to the emergency fuel check and restrictor valve assembly at the restrictor valve. Refer to Section VIII, table XLI for torque value.

(28) Connect the hose assembly (8) from the fuel manifold to the fitting on the No. 3 island cover assembly at the island cover. Refer to Section VIII, table XLI for torque value. Torque the jam nut on the check and restrictor valve to the valve in Section VIII, table XLVIII.

(29) Align the double check valve assembly (6) and torque the jam nut to value in Section VIII, table XLVIII.

Note

Make certain there is clearance between the double check valve assembly and the main fuel regulator; between the check and restrictor valve and the stopcock, and between the hose (emergency fuel to check and restrictor valve) assembly and the elbow on the lower element discharge port of the fuel pump.

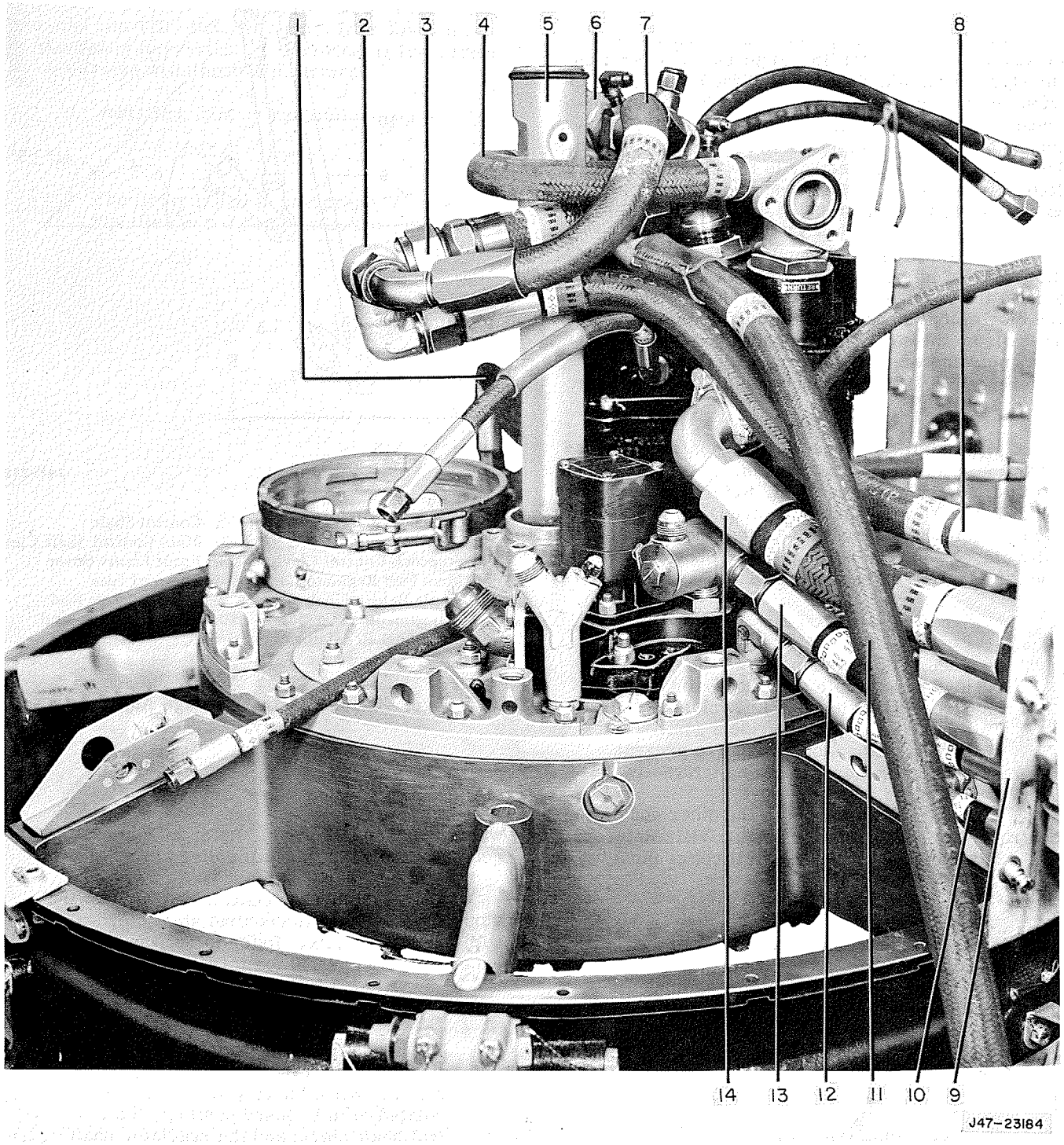
(30) Install the hose assembly (4) to the double check valve assembly. Refer to Section VIII, table XLI for torque value.

Note

The other end of this hose is connected after the fuel filter is installed.

(31) Connect the hose assembly (lube oil return from main fuel regulator) to the fitting on the front frame cover. Refer to Section VIII, table XLI for torque value.

(32) Remove the slave auxiliary drive shaft housing (5).



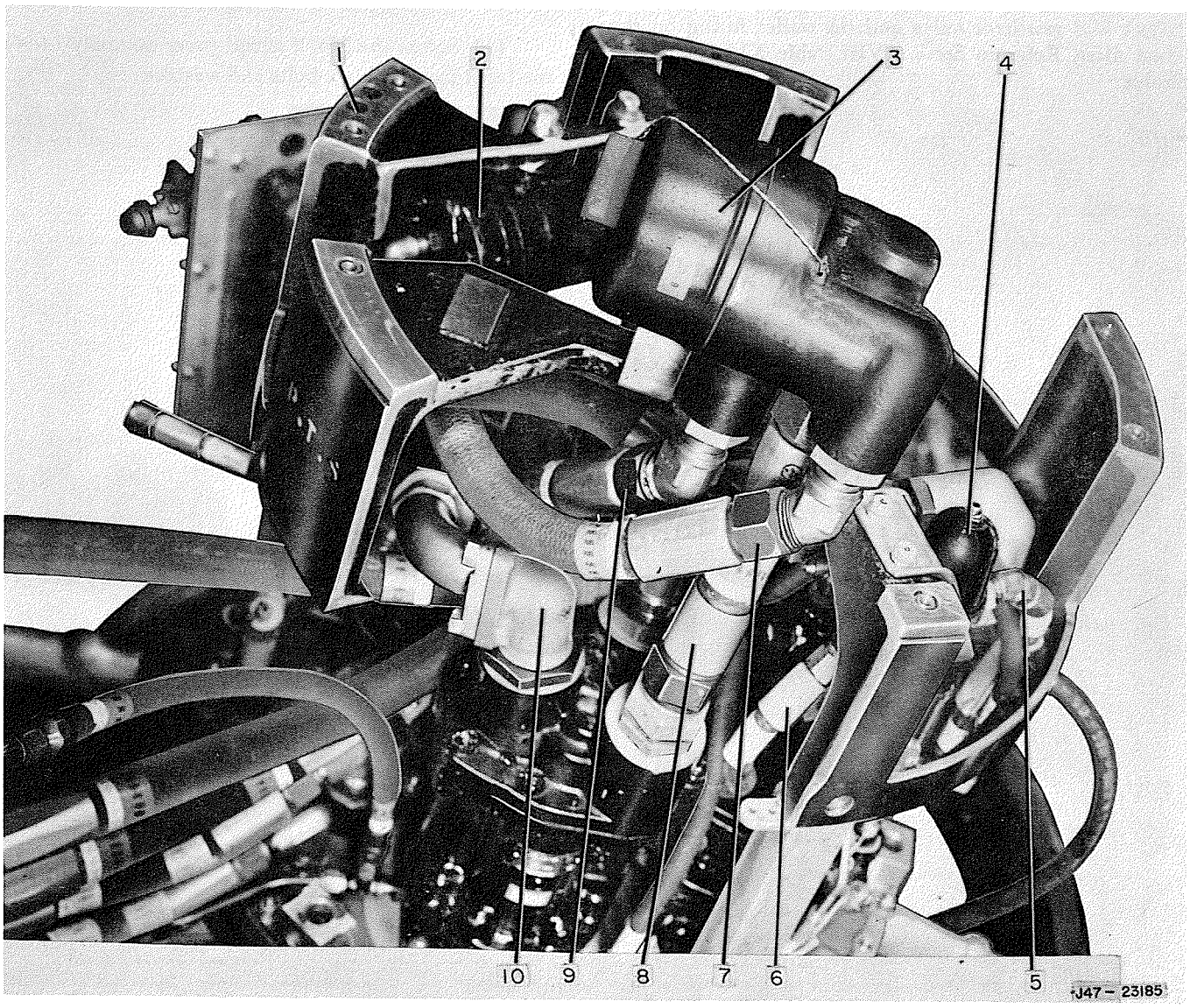
1. Lube Hose Assembly
2. Fuel Manifold
3. Fuel Hose Assembly
4. Fuel Hose Assembly
5. Auxiliary Drive Shaft Housing
6. Double Check Valve
7. Fuel Hose Assembly
8. Fuel Hose Assembly
9. No. 3 Island Cover Assembly
10. Fuel Drain Tube and Hose Assembly
11. Fuel Hose Assembly
12. Lube (Scavenge) Hose Assembly
13. Lube Hose Assembly
14. Fuel Hose Assembly

Figure 5-18. Hose Assemblies Installed, J47-27

drive casing, using 2 bolts and washers. Install O-ring seal to the fitting on the fuel by-pass port of the main fuel pump. Connect hose (10) from main fuel control valve to the fitting on the fuel return port of the fuel pump. Secure the hose assembly to the fitting at the fuel pump using 3 bolts and washers. Refer to Section VIII, table XL for torque value, and lockwire. Torque the 4 bolts on the fuel control valve side of the hose. Refer to Section VIII, table XL for torque value. Lockwire.

(3) Install the regulator filter and orifice assembly (4) to "dummy" hydraulic pump drive casing. Secure filter assembly, using 2 bolts and washers. Connect the lube oil supply hose (6) to the filter and orifice. Position the hose assembly and torque the jam nut at the elbow to the value in Section VIII, table XLVIII. Torque the hose assembly to value in Section VIII, table XLI.

(4) Connect the lube oil supply to main fuel regulator hose assembly (5) to the fitting at the discharge port of the filter and orifice. Torque the jam nut on the elbow to the value in Section VIII, table XLVIII and torque the hose assembly to the value in Section VIII, table XLI.



1. Dummy Hydraulic Pump Drive Casing
2. Main Fuel Control Valve
3. Fuel Filter
4. Lube Filter and Orifice
5. Lube Hose Assembly
6. Lube Hose Assembly
7. Fuel Hose Assembly
8. Fuel Hose Assembly
9. Fuel Hose Assembly
10. Fuel Hose Assembly

Figure 5–20. Dummy Hydraulic Pump Casing Installed, J47–27

(5) Install the fuel filter assembly (3) to "dummy" hydraulic pump drive casing. Secure the filter assembly, using two bolts.

(6) Connect the hose (8) from the fuel inlet port of the fuel filter to the fitting at the upper element fuel pump discharge port. Refer to Figure 5–4, "34" for correct fuel pump port and to Section VIII, table XLI for torque valve.

(7) Connect the hose assembly (7) from the fuel control valve assembly to the fitting at the discharge port at filter. Torque the jam nut on the elbow to the value in Section VIII, table XLVIII. Torque hose assembly to value in Section VIII, table XLI.

(8) Connect the hose assembly (9) between the check and restrictor valve and the outlet fitting on the fuel filter. Refer to Section VIII, table XLI for torque value.

(9) Remove "dummy" hydraulic pump drive casing (1) from the front frame.

Note

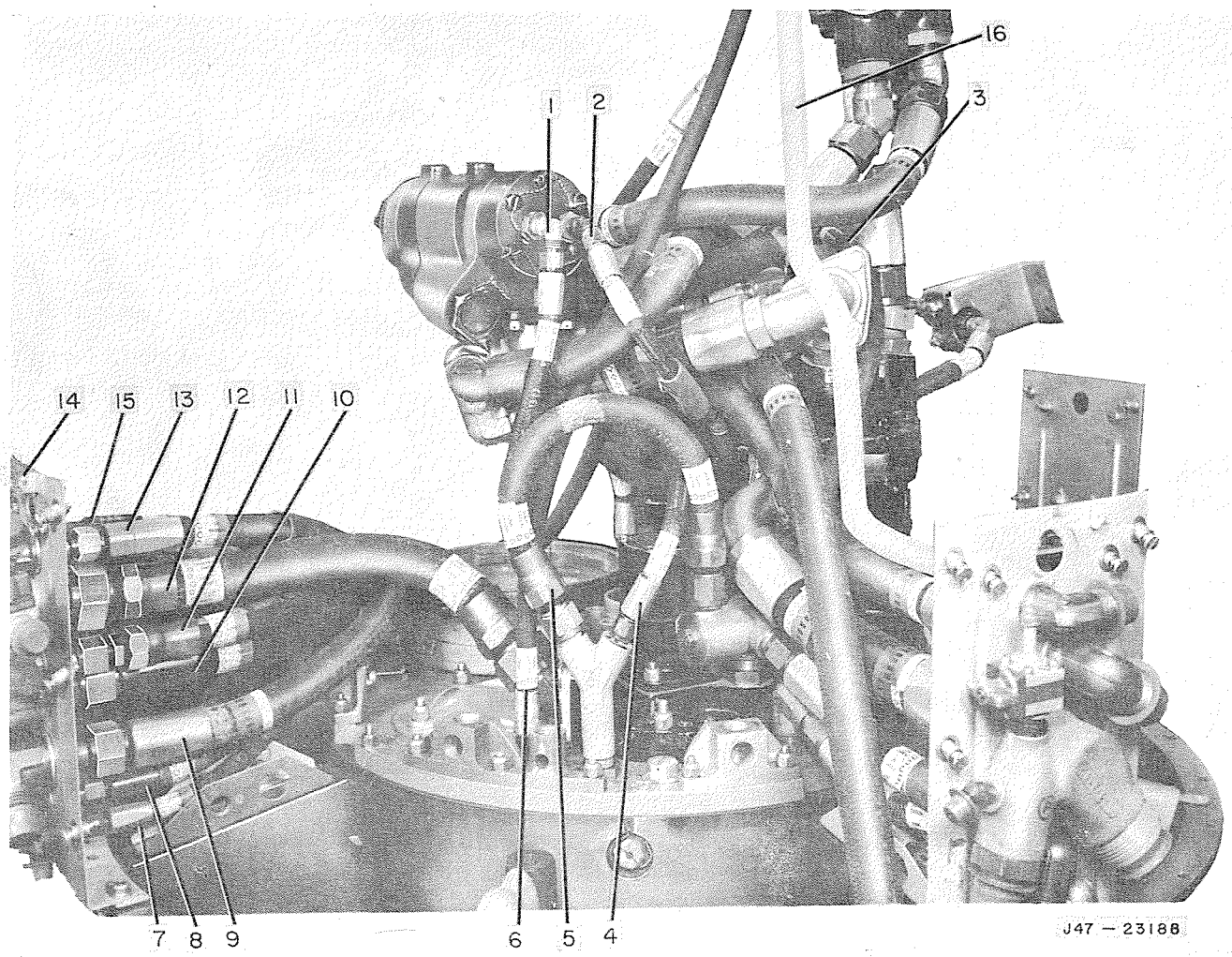
Disconnect and remove all accessories from the "dummy" casing before removing casing.

d. Install the No. 2 island cover assembly to the compressor front frame.

Note

Index numbers in step "d" are listed in figure 5–21.

(1) Secure the No. 2 island cover assembly (14) to the front frame using 2 bolts and washers.



1. Variable Control Oil Hose Assembly
2. Variable Control Leakage Return Hose Assembly
3. Fuel Drain Hose Assembly
4. Auxiliary Gearcase Scavenge Hose Assembly
5. Lube Pressure Relief Hose Assembly
6. Lube Hose Assembly
7. Hydraulic Drain Hose Assembly
8. Hydraulic Power Control Case Drain
9. Fuel Outlet to Oil Cooler
10. Hydraulic Suction Hose
11. Utility Hydraulic Pressure Hose Assembly
12. Lube Oil in Hose Assembly
13. Hydraulic Pressure Hose Assembly
14. No. 2 Island Cover Assembly
15. Hydraulic Case Drain
16. Nose Anti-Icing Tube Assembly

Figure 5–21. Installing Hoses to No. 2 Island, J47–27

Note

Do not torque the island cover retaining bolts until the sector assemblies are properly aligned to the front frame and the island cover assemblies.

(2) Assemble the hydraulic drain hose assembly (7) to the No. 2 island. Refer to Section VIII, table XLI for torque value.

(3) Assemble the hydraulic power control case drain hose assembly (8) to the No. 2 island cover. Refer to Section VIII, table XLI for torque value.

(4) Assemble the fuel outlet to oil cooler hose assembly (9) to the No. 2 island cover. Refer to Section VIII, table XLI for torque value.

(5) Assemble the hydraulic suction hose assembly (10) to the No. 2 island cover. Refer to Section VIII, table XLI for torque value.

(6) Assemble the utility hydraulic pressure hose assembly (11) to the No. 2 island cover. Refer to Section VIII, table XLI for torque value.

(7) Assemble the oil inlet hose assembly (12) to the No. 2 island cover. Refer to Section VIII, table XLI for torque value.

(8) Assemble the hydraulic pressure hose assembly (13) to the No. 2 island cover. Refer to Section VIII, table XLI for torque value.

(9) Assemble the hydraulic drain hose assembly (15) to the No. 2 island cover. Refer to Section VIII, table XLI for torque value.

(10) Connect the variable control oil hose assembly (1) to the elbow at the fuel control valve. Torque the jam nut to the value in Section VIII, table XLVI. Torque the hose assembly. Refer to Section VIII, table XLI for torque value.

(11) Connect the variable control oil leakage return hose assembly (2) to the fitting at the fuel control valve. Torque the jam nut to the value in Section VIII, table XLVI. Torque the hose assembly. Refer to Section VIII, table XLI for torque value.

(12) Install the hose assembly (5) between the lube pump pressure relief valve and the "Y" connector on the front frame. Refer to Section VIII, table XLI for torque value.

(13) Connect the drain hose assembly (3) between stopcock and tee fitting at the base of the main fuel pump. Refer to Section VIII, table XLI for torque value.

Note

Table XLI contains torque values for aluminum fittings. Make certain the proper torque value is used.

(14) Install auxiliary gearcase scavenge oil return hose assembly (4) to "Y" connector on front frame. Refer to Section VIII, table XLI for torque value.

(15) Install the lube oil supply to the auxiliary gearcase hose assembly (6). Refer to Section VIII, table XLI for torque value.

e. Install the No. 1 island cover assembly (5) to front frame.

Note

Index numbers in step "e" are listed in figure 5-22.

(1) Secure cover assembly to the front frame.

Note

Do not torque the island cover retaining bolts until the sector assemblies are properly aligned to the front frame and the island cover assemblies.

(2) Install the starter-generator (1) to the front frame. Secure to base by torquing clamp. Refer to Section VIII, Reference No. 95 for torque value.

Note

Make certain positioning lock on starter-generator is properly aligned.

(3) Connect the tachometer-generator lead (6) to the tachometer-generator and lockwire.

(4) Connect the A+ (shunt field) lead (7) to the terminal at the starter-generator. Secure the lead to the terminal using a self-locking nut. Refer to Section VIII, Reference No. 94 for torque value.

(5) Connect the starter-generator leads (2, 3, 4) to the proper terminal blocks on the starter-generator.

Note

The starter-generator leads and the terminal block are stamped with corresponding letters.

(6) Secure each lead with a bolt. Refer to Section VIII, Reference No. 93 for torque value.

(7) Lockwire each bolt to the corresponding lead.

CAUTION

Lockwire must not touch adjacent leads or electrical short-circuit will occur.

f. Assembly of accessories, J47-23, -25 and -25A. (See figure 5-24.)

Note

Index numbers for steps "f," 1 through 34 are listed in figure 5-25. See figure 5-26 front frame piping J47-23, -25 and -25A for fuel and oil flow schematic. For special tools, see Section II, group 22.

(1) Install a cover plate (3) and gasket to the auxiliary shaft gear mounting pad. Secure the cover plate using 4 nuts and washers. Refer to Section VIII, Reference No. 82 for torque value.

(2) Install the main fuel regulator assembly (1) and gasket to the front frame assembly. Secure the regulator to the front frame using 4 nuts and washers. Refer to Section VIII, Reference No. 89 for torque value.

(3) Install the lube pump and tachometer-generator assembly (4) to the front frame. Install 4 O-rings to the lube pump assembly. Secure the pump assembly to the front frame using 3 nuts and 3 washers. Refer to Section VIII, Reference No. 86 for torque value.

(4) Install the fuel pump assembly (5) and gasket to the front frame. Secure the pump assembly using 4 nuts and washers. Refer to Section VIII, Reference No. 87 for torque value.

(5) Install the starter-generator base assembly (2) and gasket to the front frame. Secure the base assembly with 6 nuts and washers. Refer to Section VIII, Reference No. 83 for torque value.

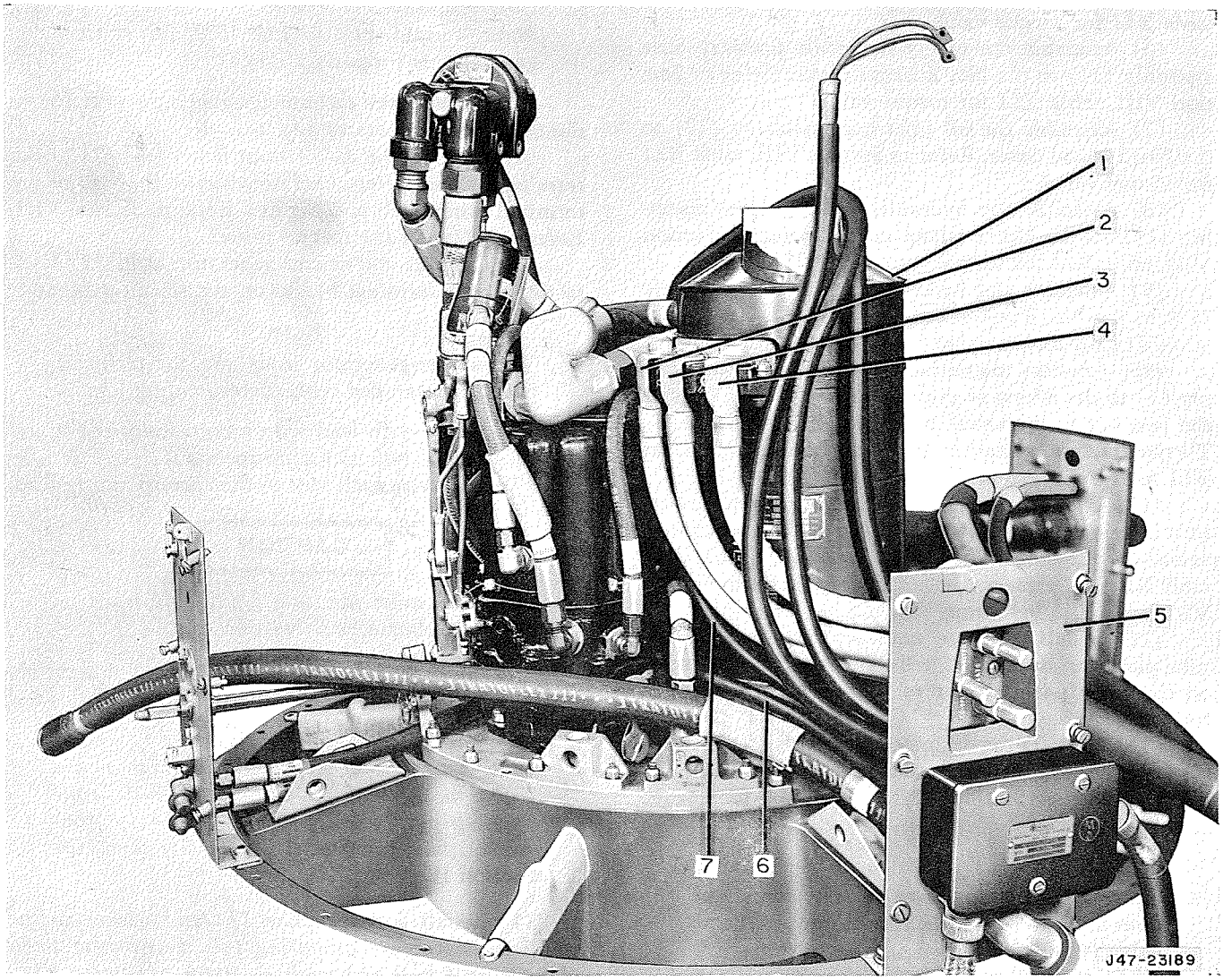
(6) Assemble the control linkage to the No. 4 island cover assembly. Refer to paragraph 5–17, step "g."

(7) Install the No. 4 island cover assembly (8) to the front frame. Secure the cover assembly to the front frame using 2 bolts and washers.

Note

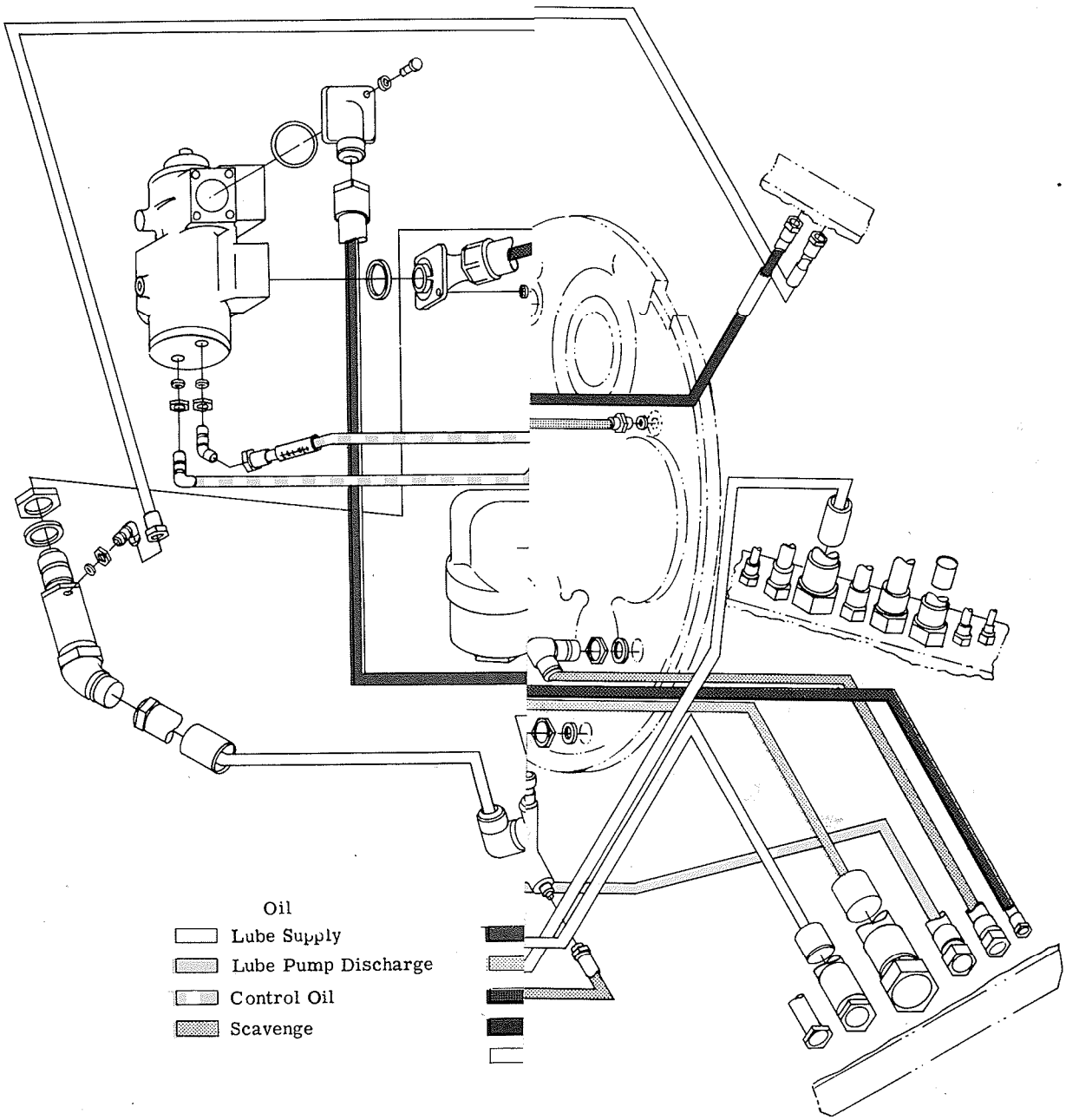
Do not torque the island cover retaining bolts until the sector assemblies are properly aligned to the front frame and the island cover assemblies.

(8) Install the compressor discharge pressure-sensing hose (9) between the fitting on the No. 4 island cover assembly and the main fuel regulator. Torque the jam nut elbow on the main fuel regulator to value in Section VIII, table XLVIII and torque hose assembly to Section VIII, table XLI on both ends.



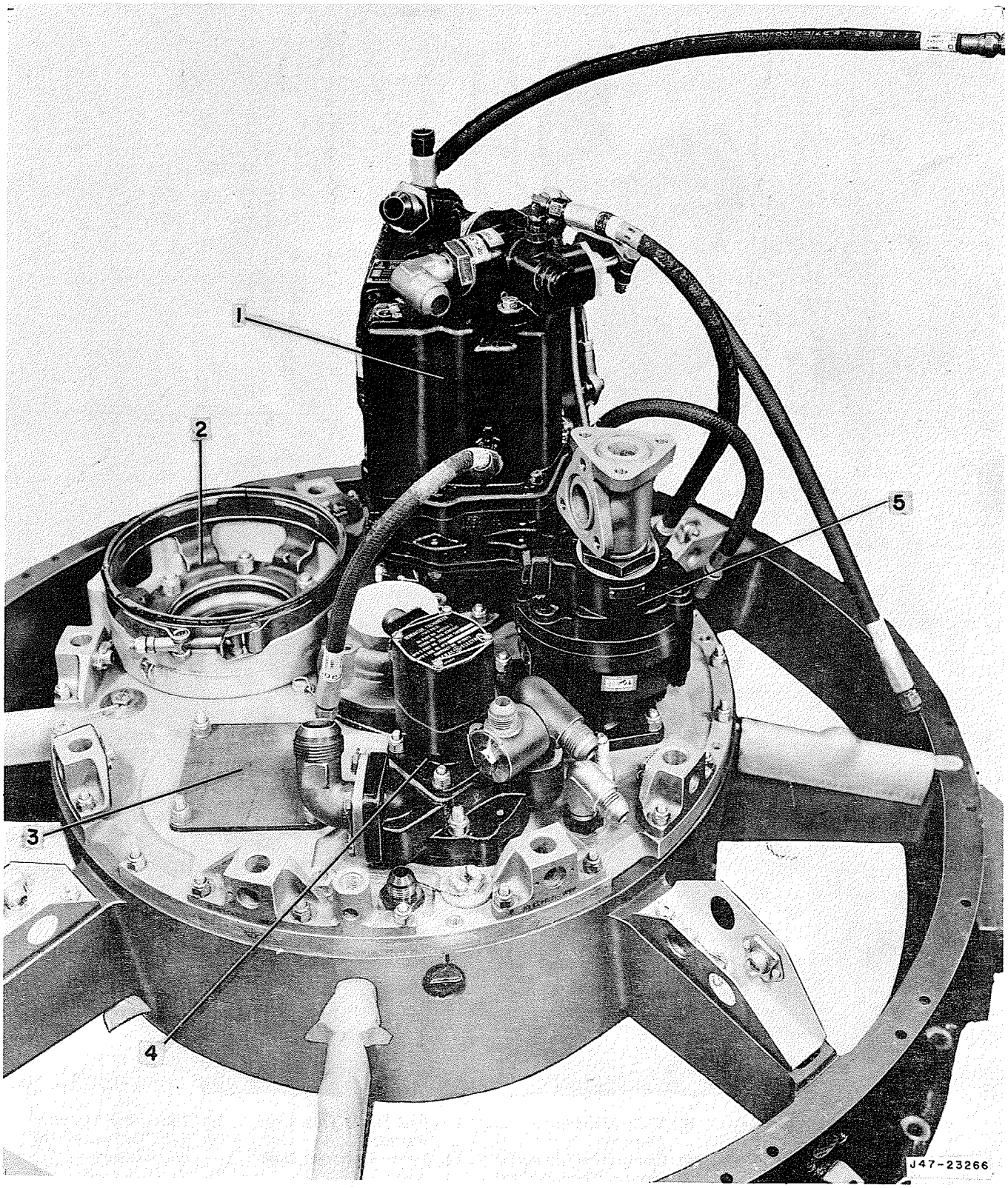
1. Starter Generator
2. Starter Generator Lead
3. Starter Generator Lead
4. Starter Generator Lead
5. No. 1 Island Cover Assembly
6. Tachometer Generator Lead
7. A+ Shunt Field Lead

Figure 5–22. Installing No. 1 Island Assembly, J47–27



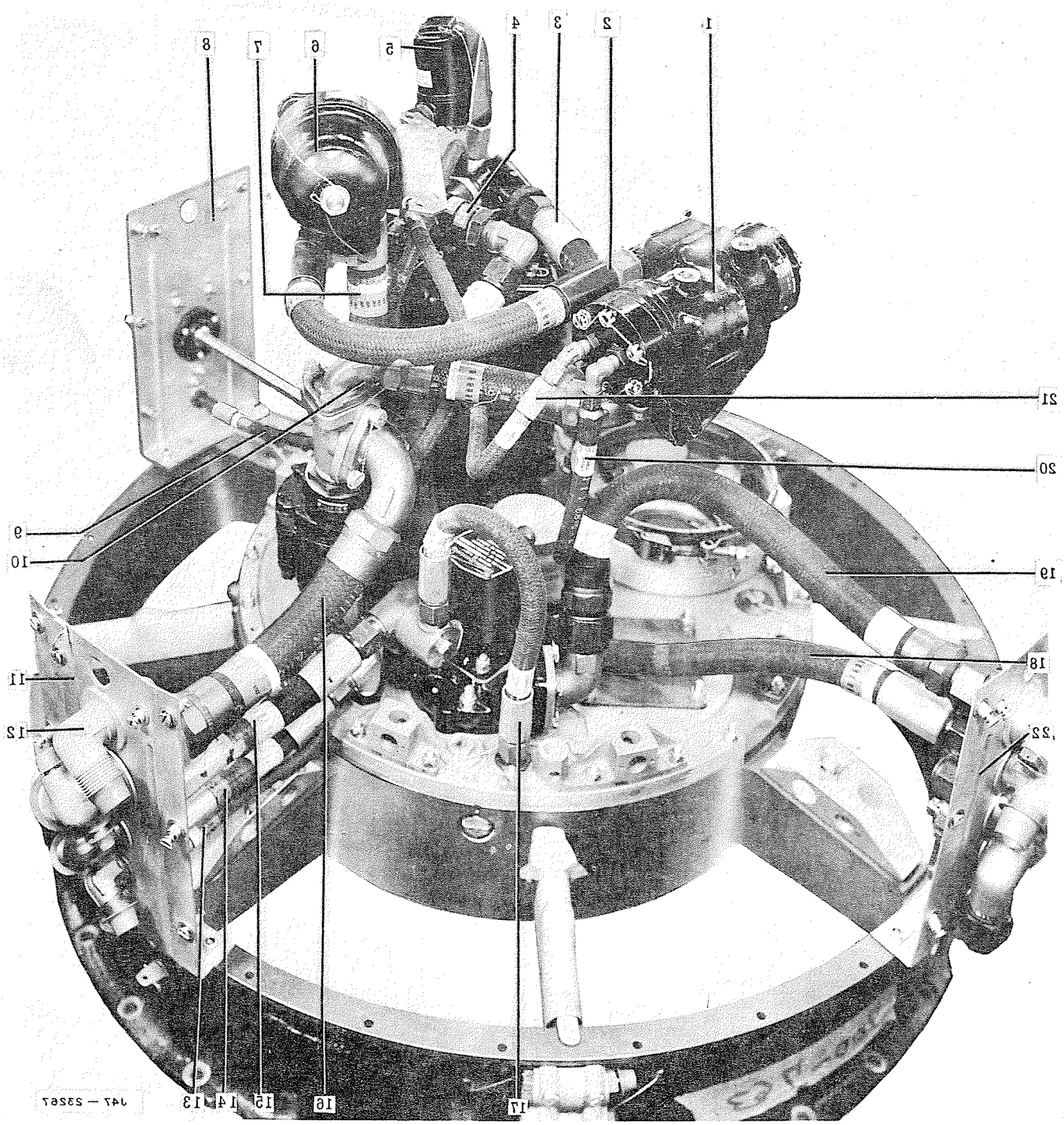
J47-23525-1

Figure 5–23.



1. Main Fuel Regulator
2. Starter Generator Base Assembly
3. Auxiliary Shaftgear Cover Plate
4. Lube Pump and Tachometer Generator
5. Main Fuel Pump

Figure 5–24. Accessories Installed on Front Frame J47–23, –25 and –25A



1. Main Fuel Control Valve
2. Fuel Hose Assembly
3. Fuel Hose Assembly
4. Fuel Drain Hose Assembly
5. Lube Filter and Orifice
6. Fuel Filter
7. Fuel Hose Assembly
8. No. 4 Island Cover Assembly
9. Compressor Discharge Pressure Sensing Hose Assembly
10. Fuel Hose Assembly
11. No. 3 Island Cover Assembly
12. Anti-Icing Elbow
13. Fuel Drain Tube Hose Assembly
14. Lube (Scavenge) Hose Assembly
15. Lube Hose Assembly
16. Fuel Hose Assembly
17. Lube (Pressure-Relief) Hose Assembly
18. Fuel Hose Assembly
19. Lube Hose Assembly
20. Variable Control Oil Hose Assembly
21. Variable Control Oil Leakage Return Hose Assembly
22. No. 2 Island Cover Assembly

Figure 5-25. Hose Assemblies Installed, J47-23, -25, and -25A

(9) Install the No. 3 island cover assembly (11) to the front frame. Secure the cover assembly to the front frame using 2 bolts and washers.

Note

Do not torque the 2 bolts until sector assemblies are assembled and properly aligned to front frame and island cover assemblies.

(10) Install drain tube and hose assembly (13) between the tee fitting at the base of the fuel pump and the fitting at No. 3 island. Refer to Section VIII, table XLI for torque value.

(11) Install the scavenge discharge hose assembly (14) between the scavenge discharge elbow on the front frame cover and the fitting at the No. 3 island cover assembly. Refer to Section VIII, table XLI for torque value.

(12) Install the lube oil pressure hose assembly (15) between the pressure relief connector and the fitting on the No. 3 island cover assembly. Torque the hose assembly at both ends. Refer to Section VIII, table XLI for torque value.

(13) Install the fuel inlet hose assembly (16) between the fitting at the No. 3 island and the main fuel pump inlet port. Install an O-ring to the fuel pump inlet port. Secure with 3 bolts and washers. Refer to Section VIII, table XLI.

(14) Install the anti-icing tube assembly (12) to the elbow on the No. 3 island cover. Refer to Section VIII, table XLI for torque value.

(15) Install the No. 2 island cover assembly (22) to the front frame. Secure the cover assembly to the front frame using 2 bolts and washers, but do not torque bolts.

Note

Do not torque the island cover retaining bolts until the sector assemblies are properly aligned to the front frame and the island cover assemblies.

(16) Install the hose assembly (18) between the stopcock discharge port and the fitting in the No. 2 island cover. Torque the jam nut on the elbow at the stopcock. Refer to Section VIII, table XLVIII for torque value. Torque the hose assembly to the value in Section VIII, table XLI.

(17) Install the lube inlet hose assembly (19) between the fitting on the No. 2 island and the lube pump. Torque the hose assembly. Refer to Section VIII, table XLI for torque value.

(18) Install the hose assembly (17) between the pressure relief valve assembly and the union on the front frame cover. Refer to Section VIII, table XLI for torque value.

(19) Install the lube oil check valve and gasket assembly to the upper portion of the front cover. Refer to Section VIII, Reference No. 139 for torque value.

Note

Make certain the arrow on the check valve points in direction of flow.

(20) Install lube hose assembly (lube pressure to filter and orifice) to check valve assembly. Refer to Section VIII, table XLI for torque values.

Note

Route the hose assembly close to the base of the main fuel regulator to prevent chafing and interference when installing starter-generator.

(21) Install a "dummy" accessory mount support to the front frame to position the lube oil filter and orifice, fuel filter, and fuel control valve.

Note

Items installed in steps (22) through (24) are installed on a dummy pad 1C2284 for positioning purposes only.

(22) Install the lube oil filter and orifice (5) to alternator pad.

(23) Connect the lube oil supply hose assembly between the filter and orifice and the main fuel regulator. Connect the lube oil supply hose assembly between the check valve and the filter and orifice. Refer to Section VIII, table XLI for torque values.

(24) Install the fuel filter (6) to alternator pad.

(25) Connect the hose (7) between the fuel filter and the discharge port of fuel pump. Torque the jam nut to the value in Section VIII, table XLVIII. Torque the hose assembly to value in Section VIII, table XLI.

(26) Install the main fuel control valve assembly (1) to the "dummy" pad 1C2284.

(27) Connect the hose assembly (3) between the fuel control valve and the stopcock. Refer to Section VIII, table XLI for torque value.

(28) Connect the hose assembly (10) between the fuel control valve and the fuel inlet port on the fuel pump. Torque the bolts. Refer to Section VIII, Reference No. 90. Lockwire.

(29) Connect the hose assembly (2) between fuel filter and fuel control valve. Refer to Section VIII, table XLI for torque value.

(30) Remove the "dummy" accessory mount support (1C2284) from the front frame.

(31) Connect the drain hose assembly (4) between the elbow fitting on the stopcock and the tee fitting at the base of the fuel pump. Refer to Section VIII, table XLI for torque value.

(32) Connect the lube oil return hose assembly between the main fuel regulator and the union on the front frame cover. Refer to Section VIII, table XLI for torque value.

(33) Connect the variable control oil hose assembly (20) between the main fuel regulator and the fuel control valve. Torque jam nut on elbow. Refer to Section VIII, table XLVIII for torque value. Torque hose assembly to value in Section VIII, table XLI.

(34) Connect the variable control oil leakage return hose assembly (21) between the main fuel regulator and the main fuel control valve. Torque the jam nut on elbow. Refer to Section VIII, table XLVIII for torque value. Torque the hose assembly to value in Section VIII, table XLI.

(35) Install the starter-generator to the front frame.

Note

Make certain positioning lock on starter-generator is properly aligned.

(36) Secure the starter-generator to the base by torquing the clamp to the value in Section VIII, Reference No. 95.

(37) Install the No. 1 island assembly to compressor front frame. Secure with 2 bolts.

Note

Do not torque the island cover retaining bolts until the sector assemblies are properly aligned to the front frame.

g. Assembly and adjustment of Main control linkage, J47–23, –25, and –25A.

Note

For special tools, see group 35, Section II. (See figures 5–27, 5–28 and 5–29.)

(1) Install the cover assembly bearing on the stopcock control shaft and hold in place with 2 retaining rings.

(2) Place the inner bearing on the lower end of the stopcock control shaft. (2, figure 5–27.)

(3) Install the stopcock clevis (4, figure 5–27) on the stopcock control shaft and secure with one bolt, nut and washer. Refer to Section VIII, Reference No. 119 for torque value. Insert cotter pins.

(4) Insert the stopcock control shaft (1, figure 5–27) (containing cover bearing assembly, inner bearing and stopcock control shaft clevis) from the underside of the No. 4 island cover plate through the hole in the island.

(5) Secure the inner bearing to compressor forward frame (5, figure 5–27) and bolt the cover assembly bearing to the No. 4 island cover plate. Refer to Section VIII, table XL for torque value. Lockwire.

(6) Rotate the stopcock shaft clockwise to the closed position.

(7) Install the stopcock clevis (7, figure 5–28) to the stopcock shaft (6, figure 5–28) at an angle of 41 plus or minus 5 degrees with the compressor front frame cover, and secure with one nut, bolt, and washer (4, 5, figure 5–28). Refer to Section VIII, Reference No. 119 for torque value.

Note

Gage set 1C2228, –1 (figure 2–21) can be used as an aid in this operation.

(8) Holding the stopcock in a full-closed position, install the 9-inch stopcock control arm, (9, figure 5–28) with rod end bearings (2, figure 5–28) between the stopcock clevis (7, figure 5–28) and stopcock control shaft clevis, (10, figure 5–28). Secure with 2 bolts, and nuts. Refer to Section VIII, Reference No. 117 for torque value. Insert cotter pins.

Note

Maintain 41 plus or minus 5 degrees at stopcock clevis and 51 plus or minus one degree at the flat end of the clevis (surface parallel to bolt passage) with the gear case cover. Gage 1C2228–1 will aid in setting and maintaining these angles.

CAUTION

The nut (1, figure 5–28) on stopcock control shaft clevis used to secure stopcock control arm must be facing up to insure proper clearance.

(9) Assemble the throttle arm (2, figure 5–29) with an adjustable pin (1, figure 5–29) held in place with one screw, (6, figure 5–29) tab washer, (4, figure 5–29) and nut. Refer to Section VIII, Reference No. 113 for torque value.

(10) Install the throttle arm to the serrated end of the stopcock control shaft on the No. 4 island at an angle of 30 plus or minus 5 degrees with the horizontal center line of engine. Secure with one bolt, nut (5, figure 5–29) and washer. Refer to Section VIII, Reference No. 119 for torque value. Insert cotter pin.

Note

Gage 1C2228–2 (figure 2–22) will aid in setting this angle. The adjustable tapered pin goes into the anti-icing port on the No. 4 island and the stud goes into the outer shaft bore. When installing the throttle arm to the stopcock control shaft, the slot on the lower end of the stopcock control shaft should be aligned with the pointer on the throttle arm.

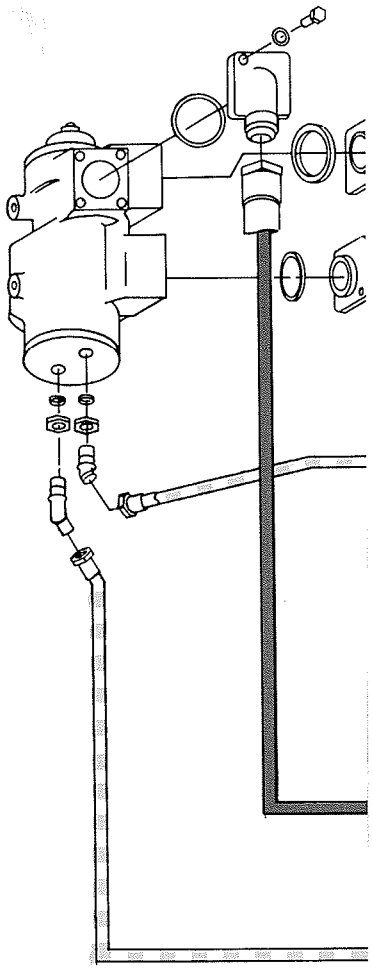
CAUTION

Adjusting pin must be in extreme counterclockwise position at this measurement.

(11) Insert the main fuel regulator control shaft, through the stopcock control shaft, making certain the regulator control shaft adjusting pin bracket fits over the adjusting pin.

(12) Install a snapring (4, figure 5–30) to the main fuel regulator control shaft at lower end of shaft.

(13) Install the fuel regulator control shaft clevis (1, figure 5–31) to lower end of the regulator control shaft with one bolt, nut, and washer. Refer to Section VIII, Reference No. 116 for torque value. Insert cotter



Fuel Pressur
Fuel Bypass
Fuel Supply
Compressed

Fi

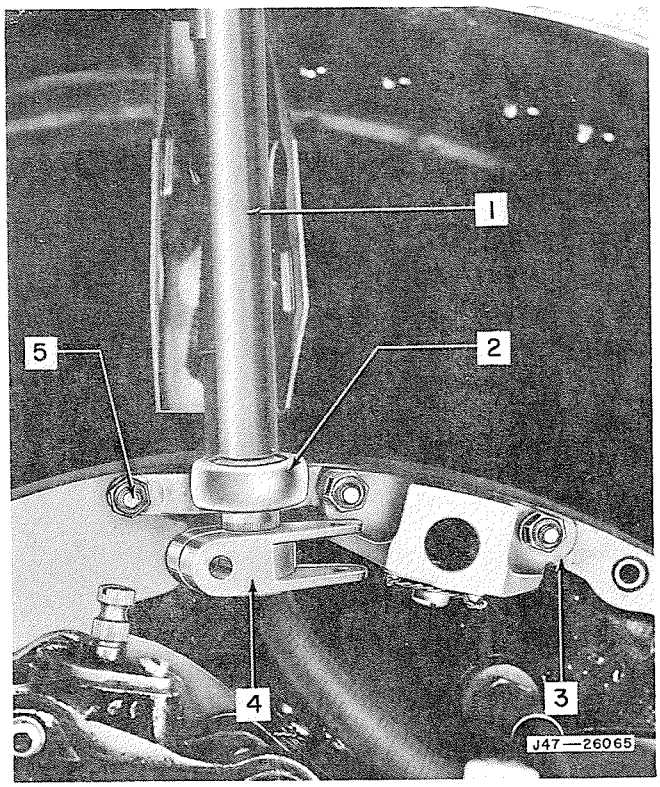
pin. The back of clevis must form an angle of 40 plus or minus 5 degrees to gear case cover.

Note

Gage 1C2228-3 (see figure 2-23) will aid in setting of this angle.

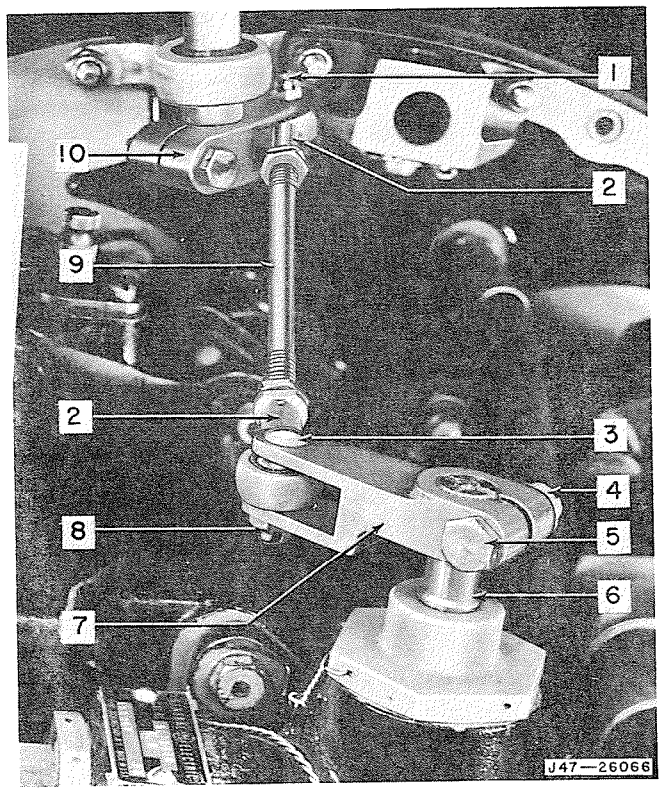
(14) Rotate the regulator shaft counterclockwise until regulator is fully closed.

(15) Install the regulator clevis (9, figure 5-32) on regulator shaft (2, figure 5-31) maintaining an angle of



1. Stopcock Control Shaft
2. Outer Bearing (Stopcock Control Shaft) and Housing
3. Support Block
4. Stopcock Control Shaft Clevis
5. Nut, Inner Bearing Housing Securing

Figure 5-27. Stopcock Control Shaft and Clevis Installed

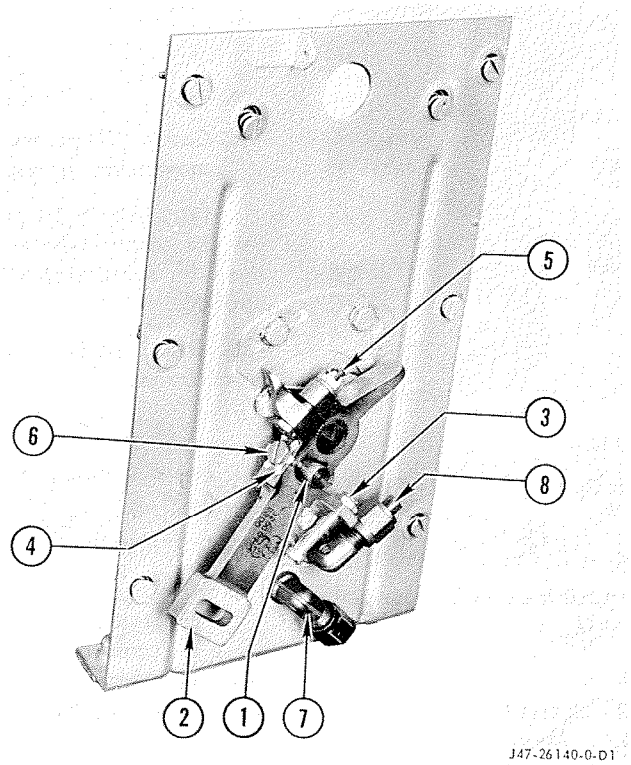


1. Nut, Stopcock Control Shaft Clevis Arm
2. Rod End Bearing
3. Bolt, Stopcock Clevis Arm
4. Nut, Stopcock Clevis
5. Bolt, Stopcock Clevis
6. Stopcock Shaft
7. Stopcock Clevis
8. Nut, Stopcock Clevis Arm
9. Control Arm
10. Stopcock Control Shaft Clevis

Figure 5-28. Stopcock Clevis and Control Arm Installed

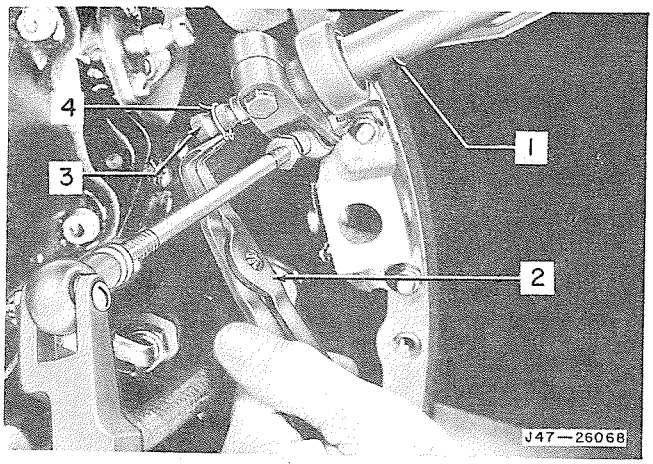
10 ± 5 degrees with the gear case cover. Secure with one bolt (7, figure 5-32) nut and washer. (Refer to Section VIII, reference No. 116 for torque value.) Insert cotterpin.

(16) With 20 lbs. of torque applied to the throttle arm, install 3-inch regulator connecting rod (4, figure 5-32) between the regulator clevis (9, figure 5-32) and regulator control shaft clevis (2, figure 5-32). Secure with nut and bolt, (1, 3, figure 5-32). Refer to Section VIII, table XL for torque value. Install cotter key.



1. Adjusting Screw Pin
2. Throttle Arm
3. High Speed Stop, Screw and Locknut
4. Tab Washer
5. Bolt, Nut and Cotter Pin-Throttle Arm
6. Adjusting Screw
7. Compressor Discharge Pressure Elbow
8. Regulator Priming Elbow

Figure 5-29. Island Throttle Arm Installed



1. Stopcock Control Shaft
2. Snapring Pliers
3. Inner Shaft (Main Fuel Regulator Control)
4. Snapring (Inner Shaft Securing)

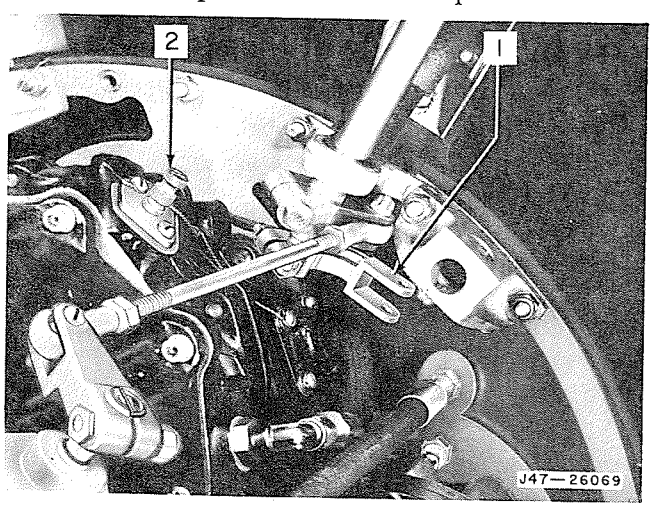
Figure 5–30. Installing Snapring on Regulator Control Shaft

Note

Install bolt (1, figure 5–32) at regulator clevis with head down and bolt (3, figure 5–32) at linkage shaft clevis with bolt head up.

(17) Disconnect one end of regulator control arm and lengthen the rod by turning the rod end 1-1/2 turns counterclockwise. This allows the fuel regulator to be open 3 degrees when the stopcock is fully closed. Secure with nut and bolt. Insert cotter pin.

(18) With throttle arm (2, figure 5–33) on the No. 4 island cover in full closed position (held full counterclockwise) adjust graduated escutcheon plate (4, figure 5–33) so pointer is in the OFF position.



1. Main Fuel Regulator Shaft Clevis
2. Main Fuel Regulator Control Shaft

Figure 5–31. Stopcock Rod and Regulator Control Clevis Installed

(19) Remove the control lever stop and replace with adjusting screw.

CAUTION

Check all points of linkage of freedom of movement, proper safetying, and nonbinding.

(20) Apply 30 pound-inches of torque to the nut on the control shaft. The throttle arm should strike the high speed stop when 30 pound-inches of torque is applied.

h. Install accessory cowl assembly over accessories to front frame.

Note

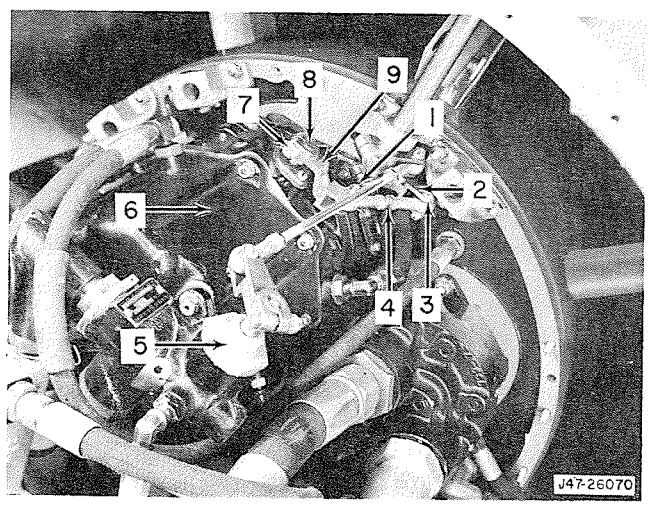
Index numbers in step "h" are listed in figure 5–35.

(1) Install a drain seal to accessory cowl at 6 o'clock position.

(2) Secure the cowl assembly to the front frame using 8 (centering) Allen-head bolts. Refer to Section VIII, Reference No. 71 for torque value. Install snaprings to lock each bolt in place.

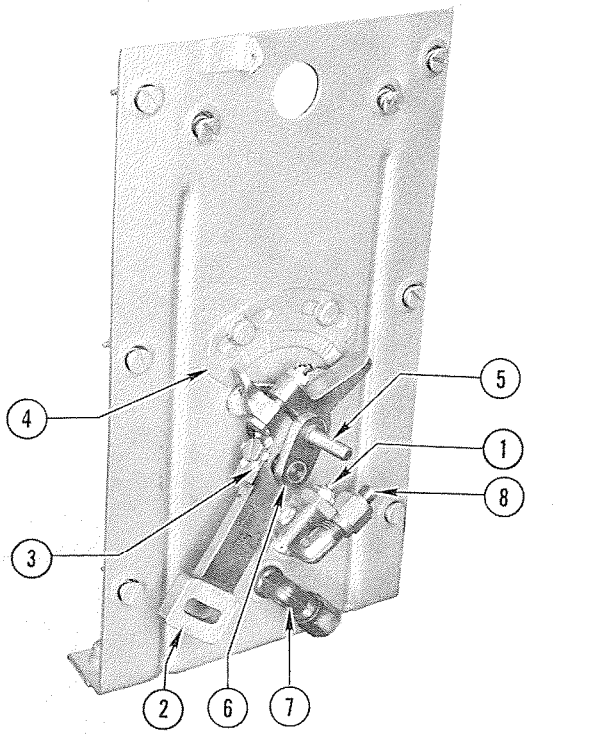
CAUTION

Use care to properly seat snaprings into provided recesses.



1. Bolt, Main Fuel Regulator Clevis Arm
2. Main Fuel Regulator Control Shaft Clevis
3. Bolt, Main Fuel Regulator Control Shaft Clevis Arm
4. Main Fuel Regulator Control Arm
5. Stopcock
6. Main Fuel Regulator
7. Bolt, Main Fuel Regulator Clevis
8. Main Fuel Regulator Shaft
9. Main Fuel Regulator Clevis

Figure 5–32. Fuel Control Linkage Installed



1. High Speed Stop, Screw and Locknut
2. Throttle Arm
3. Tab Washer and Adjusting Screw
4. Escutcheon Plate
5. Inner Shaft (Main Fuel Regulator Control)
6. Adjusting Screw Pin
7. Compressor Discharge Pressure Elbow
8. Regulator Priming Elbow

Figure 5-33. Island Throttle Arm and Regulator Control Shaft Installed

Note

Make certain that lube oil supply hose between filter and orifice, and main fuel regulator is free of stringer within the accessory cowl.

(3) Install the air inlet duct sector assemblies (2) to the front frame and align to island cover assemblies.

(4) Secure each sector to the front frame using 6 bolts and washers. Refer to Section VIII, Reference No. 106 for torque value.

Note

Install 2 island fairing assemblies (left and right) between the island cover and the sector assemblies on islands 2, 3 and 4 before securing camlock fasteners on the covers.

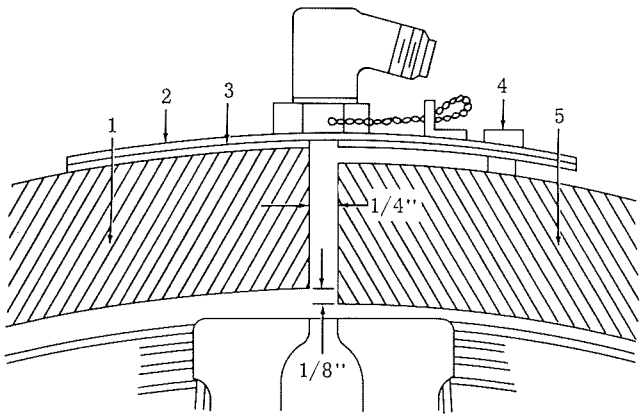
(5) Secure the island cover assemblies to sector assemblies by fastening camlocks.

(6) Torque the island cover retaining bolts. Refer to Section VIII, Reference No. 106 for torque value.

(7) Install 4 island fairings to the compressor front frame and secure with 2 camlock fasteners each.

Note

The following steps are applicable to engines having Inlet Screens. Accept 1/4 inch gap between sector assemblies and 1/8 inch gap in the radius of the sectors from the center line of the engine. (See figure 5–33A.)



1. Quadrant Assembly
2. Island Cover
3. Island Fairing
4. Camloc Fastener
5. Quadrant Assembly

Figure 5–33A. Sector Inspection

(8) Install screen actuator motor and 8 flexible shafts (3) to front frame.

Note

Install 4 vertical flange bolts and washers into mounting holes directly aft of screen actuator motor before installing motor on engine.

(9) Secure long flexible shafts to 3 brackets (3) provided on the front frame and to actuator housings (1). Refer to Section VIII, Reference No. 107 for torque value.

5–18. INSTALLING THE NO. 1 BEARING AND NO. 1 AIR-OIL SEAL.

Note

For special tools, Section II, see group 5.

a. To install the No. 1 bearing housing assembly to the front frame housing bore apply grease, Specification MIL-G-23827, to the bearing housing to prevent chafing.

b. Install the No. 1 bearing outer race and roller assembly to the No. 1 bearing housing using pusher 1C842–6 and 1C842–1. (See figure 5–36.)

c. Apply grease, Specification MIL-G-23827 to the front frame bore and install the bearing and housing assembly. Secure the housing to the front frame with 3 long bolts, with washers and lugs, and 3 short bolts with washers (no lugs). Refer to Section VIII, table XL for torque value. Lockwire. (See figure 5–37.)

d. To install air-oil seal assembly to the rear face of the front frame, apply lubricant, Specification MIL-G-23827 to gasket mounting surfaces. The lubricant aids in keeping the gasket aligned.

e. Install 2 gaskets to the seal assembly and position the seal to the rear face of front frame.

f. Secure the seal assembly using 20 bolts and washers on the outer circle and 12 bolts and washers on the inner circle. Refer to Section VIII, table XL for torque value.

Note

Torque the bolts alternately to make certain that the seal assembly is torqued evenly.

g. Lockwire the inner circle of bolts. Lockwire two-thirds of the outer circle of 20 bolts. Complete lockwiring after the installation of the inlet guide vane assembly to the front frame. (See figure 5–38.)

5–19. INSTALLING THE INLET GUIDE VANE TO COMPRESSOR FRONT FRAME.

a. Install the inlet guide vane assembly to front frame.

b. Secure the inlet guide vane to the front frame with 4 bolts (no washers). Refer to Section VIII, Reference No. 136 for torque value.

c. Lockwire each inlet guide vane retaining bolt to the adjacent seal retaining bolts. (See figure 5–39.)

d. Install a connector tee to each side of the front frame assembly on J47–25 and –25A engines.

Note

Install 2 bolts to each side of the rear flange of the front frame before installing connector tee.

(1) Install 8 bolts into provided slots in vane assembly.

(2) Install a gasket over the 8 bolts.

(3) Secure each connector tee using 8 nuts and washers. Refer to Section VIII, Reference No. 137 for torque value.

e. Install a connector tee to each side of compressor front frame assembly on J47–23.

Note

Install 2 bolts to each side of rear flange to front frame before installing connector tee.

(1) Install 4 bolts into provided slots in vane assembly.

(2) Install gasket over the 4 bolts.

(3) Secure each connector tee using 4 nuts and washers. Refer to Section VIII, Reference No. 137 for torque value.

5–20. COMPRESSOR STATOR CASINGS.

CAUTION

When assembling components to compressor stator casings, care must be used in selection of bolts of proper size due to danger of damaging compressor blades.

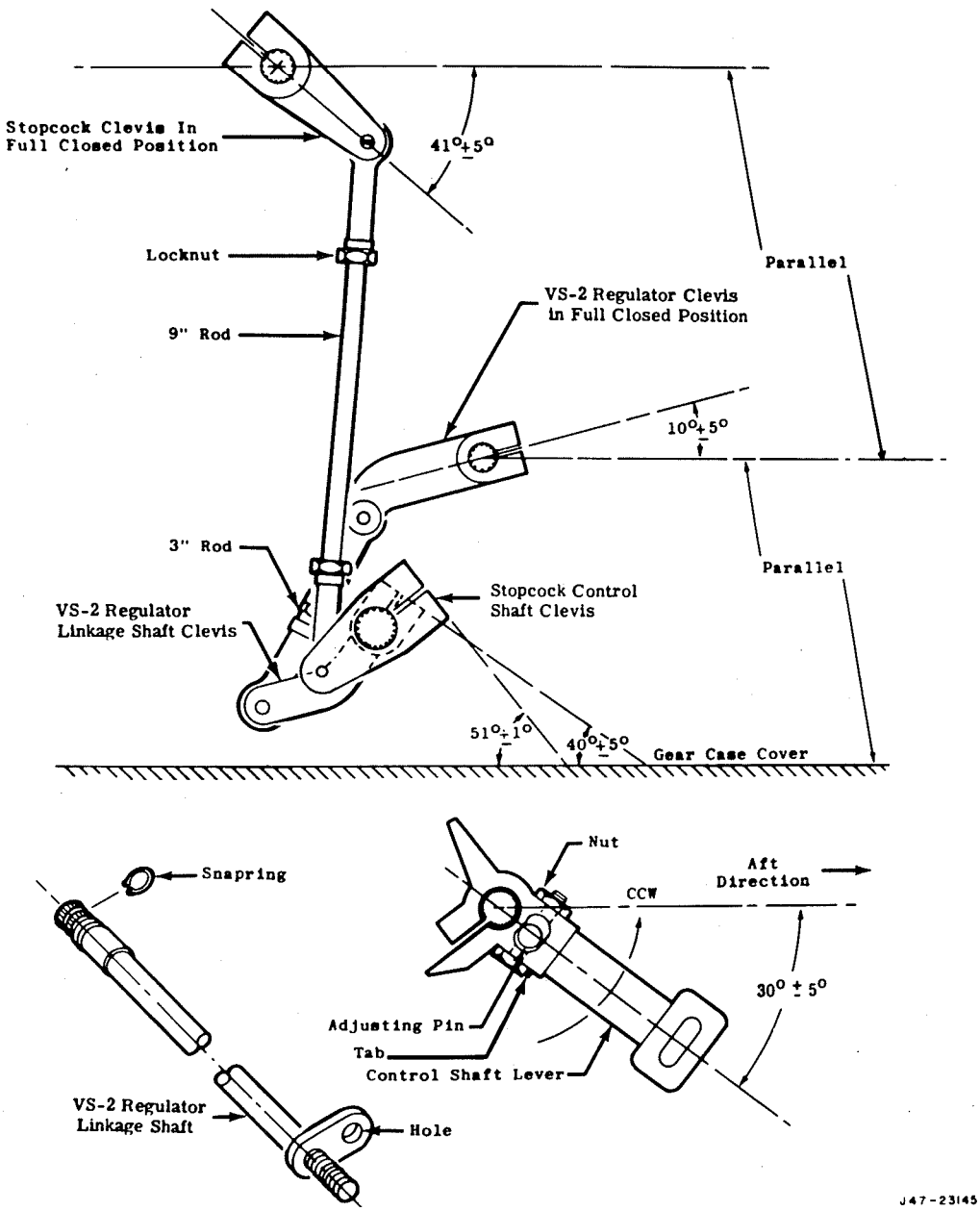


Figure 5–34. Main Control Linkage Assembly for J47–25A

Figure 5–45. Deleted

Figure 5–46. Deleted

5–33. BUILD UP OF THE REAR FACE OF THE COMPRESSOR REAR FRAME.

Note

Throughout this paragraph the numbers in parentheses refer to figure 5–51 except where stated otherwise. For special tools see group 15, Section II.

a. Deleted.

b. Deleted.

c. Deleted.

d. Deleted.

e. Deleted.

f. Deleted.

g. Deleted.

h. Install 2 transfer tubes with "O" rings assembled as shown in figure 5-47.

(1) Install large transfer tube, (13) into scavenge pump drive shaft, using pusher puller, 1C2047.

(2) Install small transfer tube, (14) to scavenge pump oil inlet opening, using pusher puller, 1C2276.

i. Install the scavenge pump gear train assembly (22) using 3 bolts and washers. Refer to Section VIII, Reference No. 160 for torque value. Lockwire.

j. Install the gear housing lube oil drain plug (11) and gasket into oil shield. Refer to Section VIII, Reference No. 159 for torque value. Lockwire.

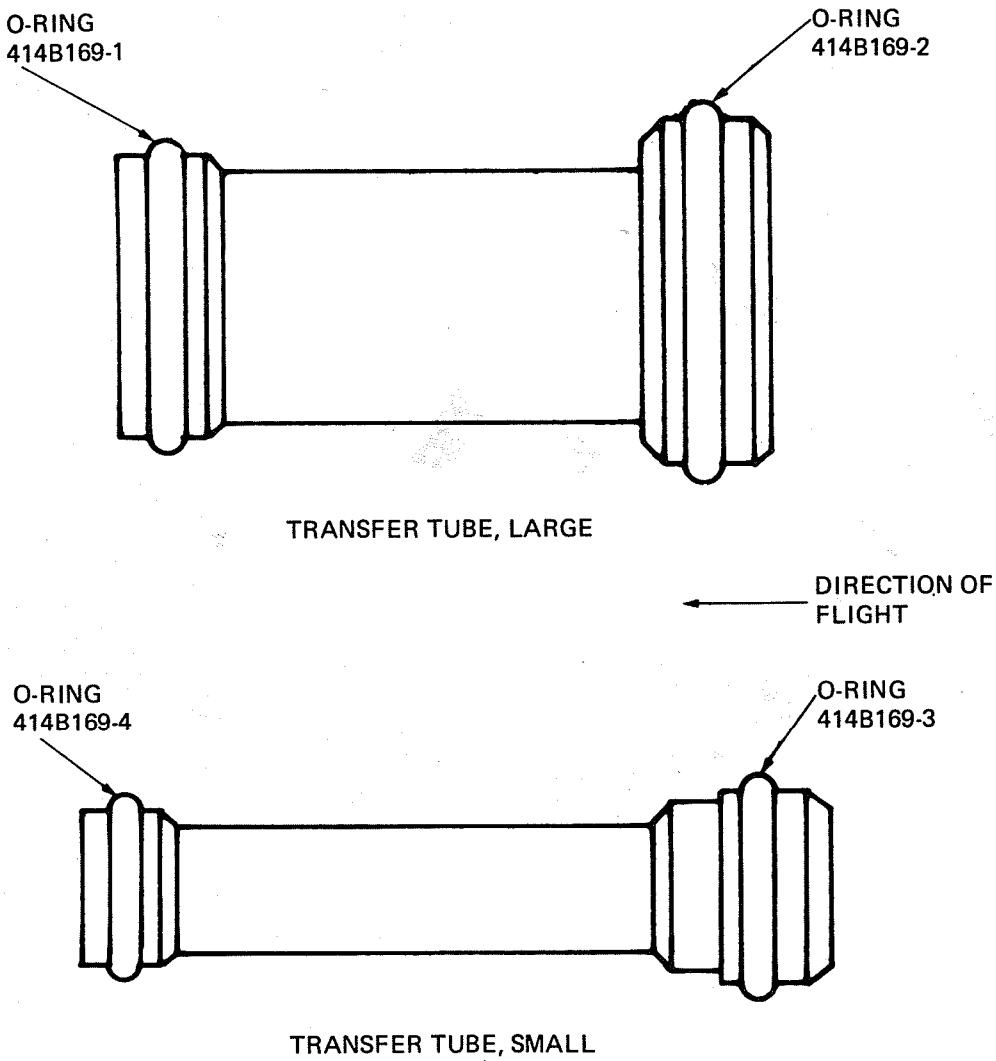


Figure 5-47. Transfer Tubes, Scavenge Oil

5–34. EXTERNAL ASSEMBLY OF COMPRESSOR REAR FRAME.

Note

Throughout this paragraph the numbers in parentheses refer to figure 5–51 except where stated otherwise.

a. Install 3 manifold take-off covers (12) one between No. 1 and 2, 4 and 5, and 7 and 8 combustion chamber ports on outer circumference of rear frame with one gasket, 4 bolts and washers per cover. Refer to Section VIII, Reference No. 165 for torque value, and lockwire.

b. Install 3 fiber board covers on twelfth stage leakage vent ports, one at 3, 9, and 12 o'clock positions. (See figures 5–50 and 5–51.)

c. Install one lube inlet elbow with nut and gasket between No. 5 and 6 combustion chamber ports.

d. Install one elbow with nut and gasket to the scavenge pump lube outlet fitting. (See figure 5–49.)

Note

In steps "c" and "d" above, elbow locknuts are torqued during assembly of major assemblies.

e. Install scavenge pump lube outlet fitting and gasket at 6 o'clock position and secure with 4 bolts and washers. Refer to Section VIII, table XL for torque value and double lockwire.

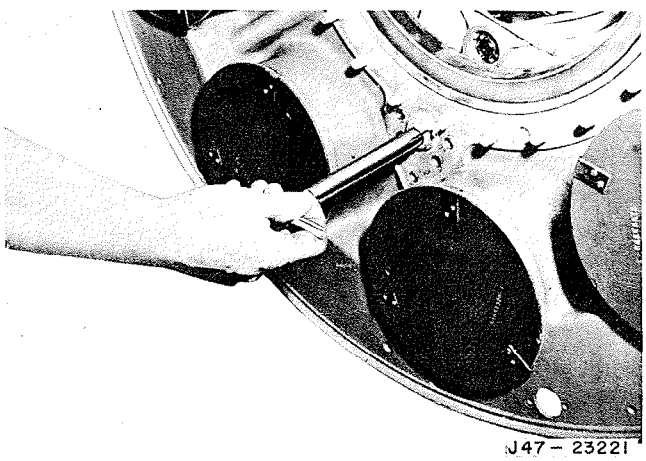


Figure 5–48. Installing Transfer Tube into Scavenge Pump Drive Shaft Bore

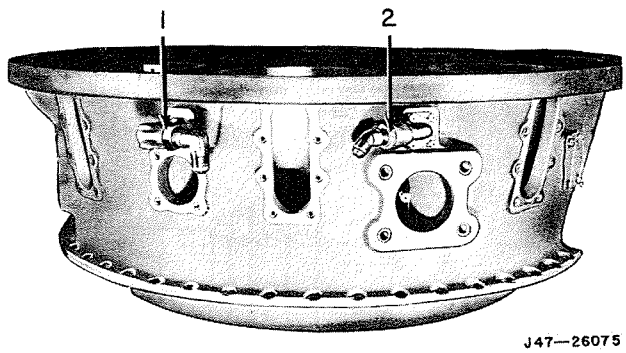
f. Install one union and gasket to turbine wheel cooling air tube located between combustion chambers No. 1 and 2 on compressor rear frame. Refer to Section VIII, table XLVIII for torque value.

Note

Before installing the above steel fitting, apply a light coating of anti-seize compound Specification MIL-L-25681.

g. Install one screw, one gasket, one nut and 2 washers into rear firewall flange to plug hole at 6 o'clock position. Torque.

h. Install 4 screws, washers and nuts into rear firewall flange one at 1, 6, 7 and 11 o'clock positions.



1. Lube Oil Inlet
2. Lube Oil Return

Figure 5–49. Lube Oil Fittings Installed on Compressor Rear Frame

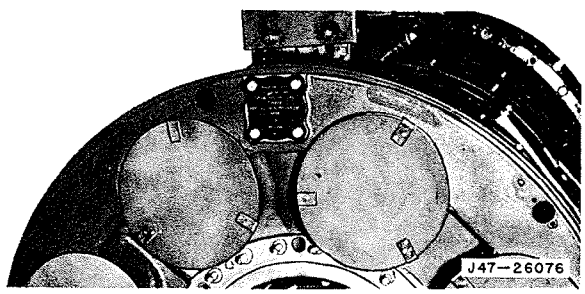


Figure 5–50. Covers Installed on Burners and Twelfth Stage Leakage Ports

i. Install the coverplate and gasket and secure with 2 bolts, nuts, and 4 washers to plug opening at one o'clock position in firewall flange. Refer to Section VIII, table XL for torque value.

5–35. COMBUSTION SECTION.

5–36. ASSEMBLY OF COMBUSTION CHAMBERS.

5–37. BUILD UP OF THE COMBUSTION CHAMBERS.

a. Assemble rear drain tubes to outer combustion chambers. Secure with washer and lugnut on each. Refer to Section VIII, Reference No. 17 for torque value. Lockwire lugnut to tube inside chamber.

b. Assemble front drain tubes to No. 1, 3, 4, 5, 6, and 8 outer chambers. Secure with lugnut and washer on each. Refer to Section VIII, Reference No. 170 for torque value. Lockwire lugnut to tube on inside of chamber.

c. Assemble the water injection gaskets to the nozzles and install 4 nozzles in each chamber. Refer to Section VIII, Reference No. 177 for torque value. Lockwire each nozzle gasket in each chamber.

Note

Water injection nozzles are installed on J47–25 and –25A engines only.

d. Install the inner combustion chamber into outer combustion chamber. (See figure 5–52.)

e. Install cross-ignition tubes and secure with single strand heat-resistant lockwire.

CAUTION

If cross-ignition tubes are of the drop-in type which do not have lugs for lockwiring to chambers, make certain that both tubes are engaged in inner liner eyelet. This type should be rechecked when chambers are installed on engine.

Note

The cross-ignition tubes both position and secure the inner chamber.

f. Install exit ring in aft end of each chamber and lubricate bolt holes with high temperature anti-seize compound MIL-L-25681. (See figure 5-53.)

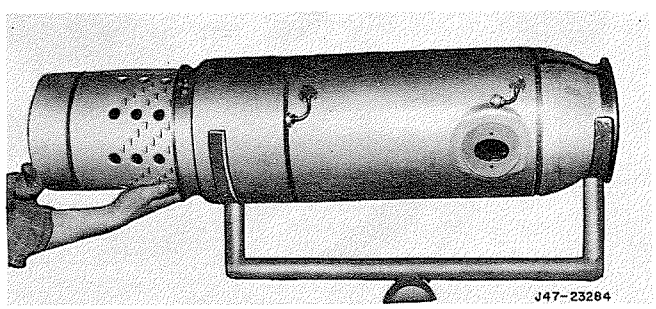


Figure 5–52. Installing Inner Combustion Chamber

g. Install exit ring bolts (figure 5–54) and torque to value in Section VIII, Reference No. 175.

Note

To assemble combustion chambers with bellows type cross-ignition tubes, install inner chamber into outer chamber, making certain cross-ignition holes are in line.

5–38. TURBINE SECTION.

5–39. ASSEMBLY OF TURBINE SECTION.

5–40. BUILD UP OF THE TURBINE FRAME.

Note

Throughout this paragraph the numbers in parentheses refer to figure 5–78 except where stated otherwise. For special tools see Section II, group 36.

a. Install turbine frame (24) into stand 1C632 in a horizontal position using sling 1C896 (figure 5-55).

b. Install No. 4 bearing housing (30) to turbine frame.

(1) Chill the housing in a dry ice bath approximately 15 minutes prior to installation. Refer to paragraph 5–4.

(2) Align the housing and press it into the turbine frame using a suitable non-metallic pusher.

c. Install the No. 4 bearing outer race (34) to the No. 4 bearing housing.

(1) Chill the outer race in dry ice for approximately 15 minutes. Refer to paragraph 5–4.

(2) Align the outer race and press into bearing housing, using a suitable pusher (figure 5–56).

d. Install the No. 4 bearing oil jet bracket (33) to the No. 4 bearing housing and secure it with 2 screws. Refer to Section VIII, table No. XL for torque value.

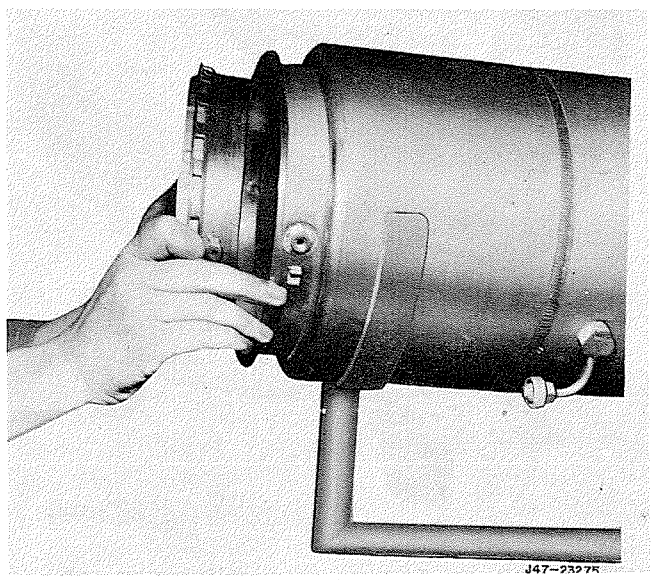


Figure 5–53. Installing Exit Ring

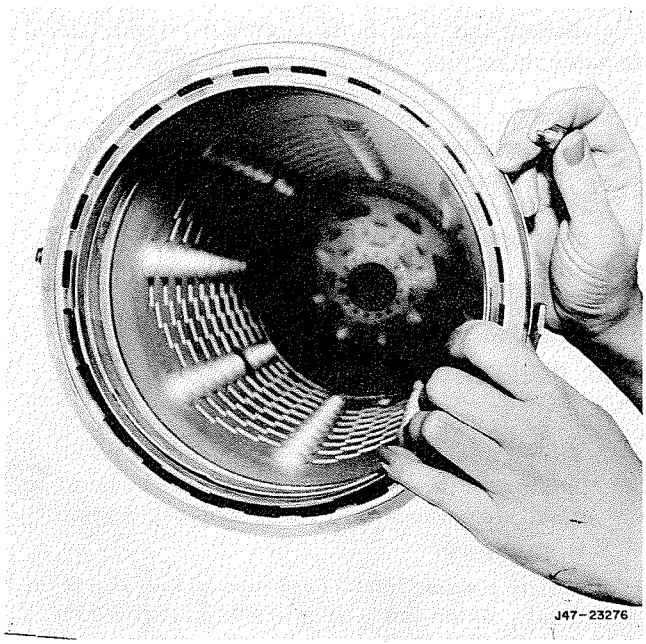


Figure 5-54. Installing Exit Ring Bolts

e. Install the No. 4 bearing lube oil tube assembly (37) to the turbine frame.

(1) Install grommet (35) to the oil tube.

(2) Secure the oil tube with 2 clamps (38, 32), screws and washers. Refer to Section VIII, table No. XL for torque values.

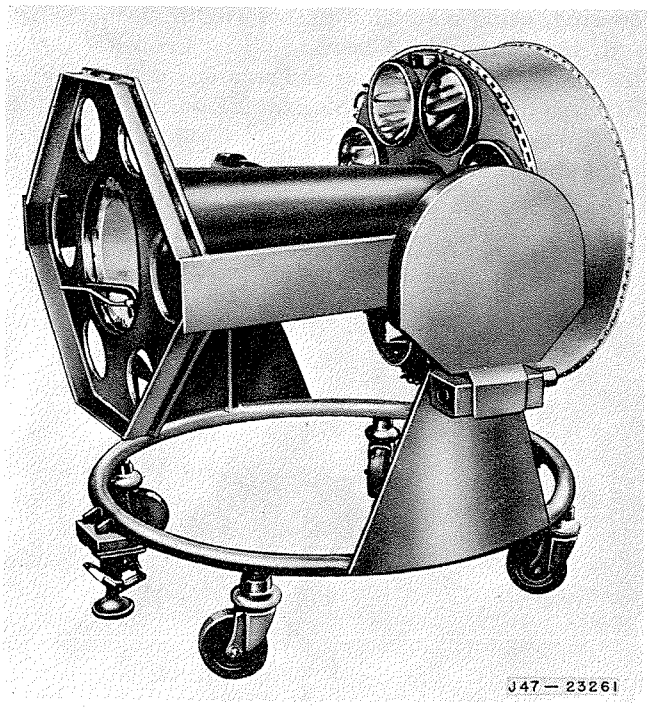


Figure 5-55. Turbine Frame Installed in Turbine Frame Stand Tool No. 1C632

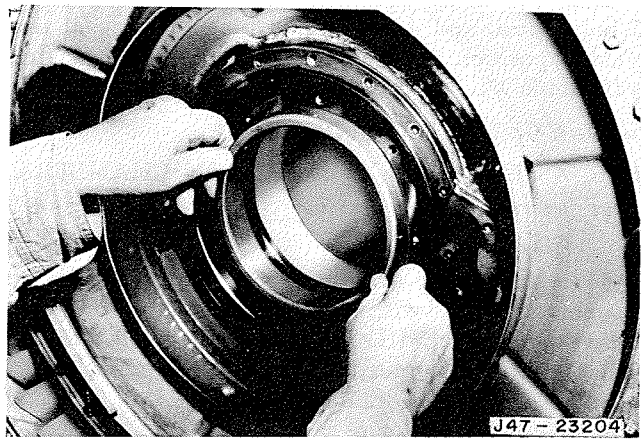


Figure 5-56. Installing No. 4 Bearing Outer Race

(3) Use template gauge selected from 1C772 gauge set to check clearance between housing and oil jet (figures 5-57 and 5-58).

f. Use plug gauge selected from 1C772 gauge set to check oil jet height. (See figures 5-59, 5-60, and 5-61.)

Note

This check is made to assure a proper oil spray pattern to the bearing.

g. Assemble lube oil tee (20) by installing one packing (19, 22) and one nut (18, 23) to each side of oil tee. Thread nuts on finger-tight.

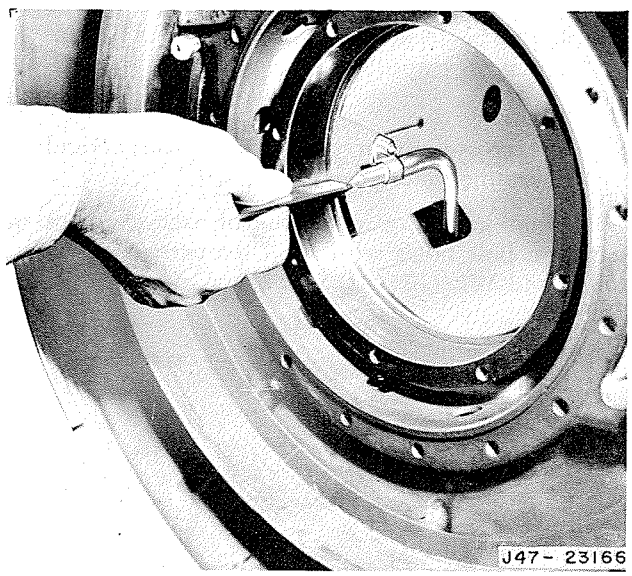


Figure 5-57. Template Gage, Tool No. 1C772

Note

Assemble lube oil tee (20) during steps "h", "j" and "n" by installing the coupling nuts and packings on the tube prior to inserting the tube into the tee.

h. Install oil tee inside the turbine frame connecting the tee to the No. 4 bearing oil tube assembly.

i. Install the rear oil shield assembly (14) to the turbine frame. Oil shield flange must be seated properly (see figure 5-62).

j. Install oil (feed) tube assembly (16) to the forward portion of turbine frame with a clip assembly (17). Refer to Section VIII, table XL for torque value. Lockwire.

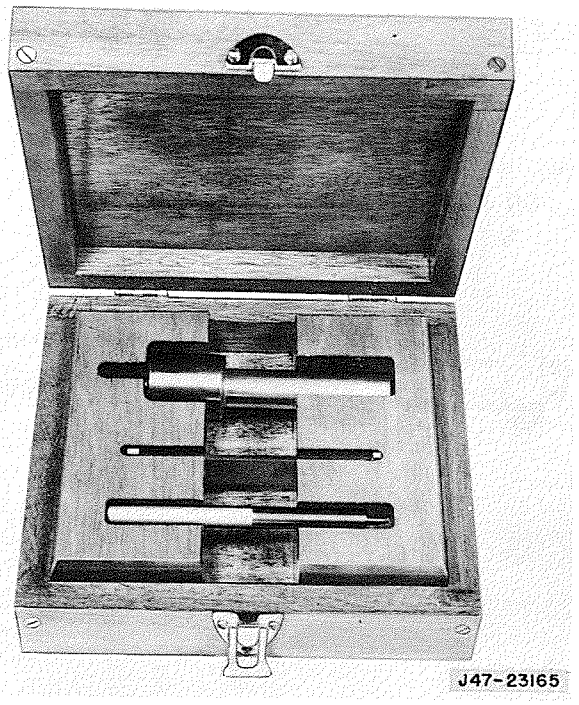


Figure 5-58. Gauge Set, Tool No. 1C772

k. Assemble No. 3 damper bearing assembly (7, 10, 11) as follows:

(1) Slide bearing outer race and roller assembly (10) into bearing housing (11).

(2) Install ring assembly (7) to the damper bearing housing.

(3) Secure the ring assembly to damper bearing housing using sixteen bolts. Refer to Section VIII, Reference No. 191 for torque value. Lockwire in groups of 4.

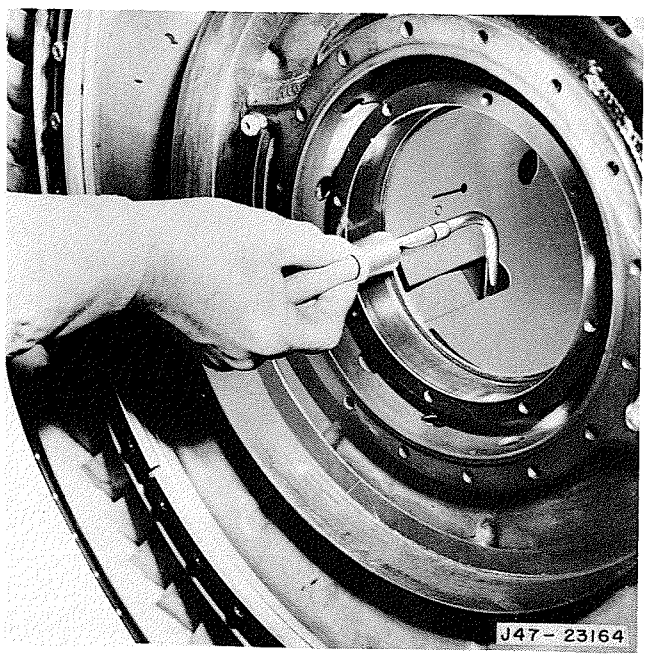


Figure 5-59. Aligning No. 4 Bearing Oil Jet

Note

Do not lockwire over 3 lube drain ports.

l. Install the No. 3 bearing assembly to turbine frame (24) as follows:

Note

Make certain 3 oil drain holes in bottom (6 o'clock position) are lined up.

(1) Use 3 guide pins of proper size at the 12, 3, and 9 o'clock positions to align bearing assembly to turbine frame (figure 5-63).

(2) Install 5 springs (8) having guides (6, 9) on each end. Install a washer (5) and nut (4) to each stud. Refer to Section VIII, Reference No. 190 for torque value; then back nuts fully one-half turn and insert cotter pins (3).

Note

It may be necessary to continue slight counterclockwise rotation to align key hole. Cotter pins are bent so that one tab is extended over castellated nut and the other leg along the stud.

(3) Remove the 3 guide pins and install the remaining 3 springs; assemble with washers and nuts. Refer to Section VIII, Reference No. 190 for torque value; then back nuts off fully one-half turn and insert cotter pins.

Note

A piece of lockwire may be helpful in locating holes on studs.

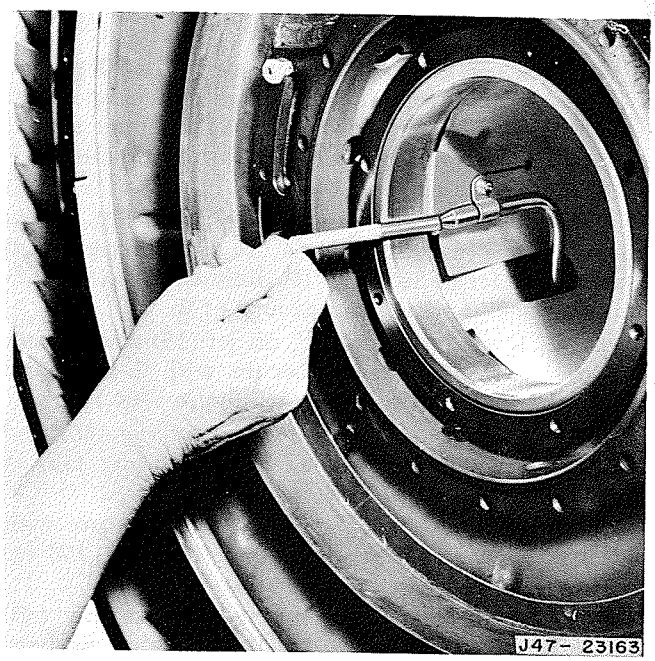


Figure 5-60. Aligning No. 4 Bearing Oil Jet with Outer Race Installed, Plug Gauge (Height Aligning), Tool No. 1C772

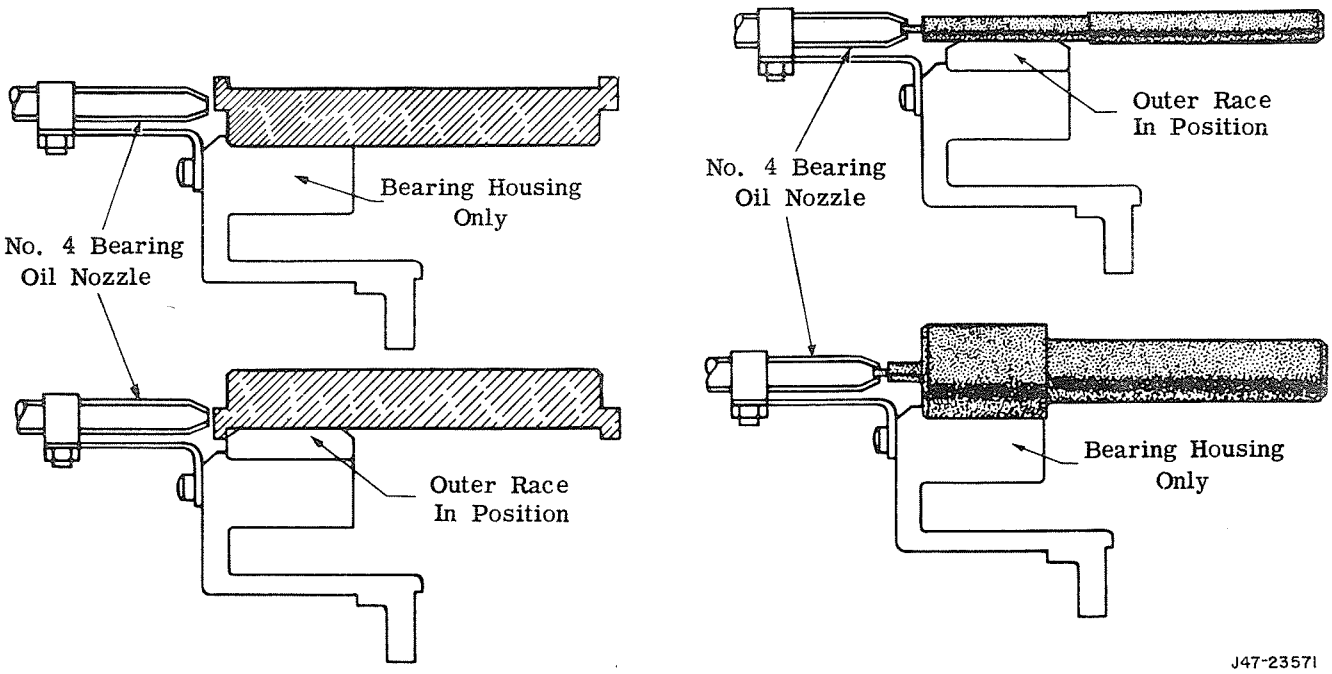


Figure 5-61. Aligning No. 4 Bearing Oil Jet Using Gauge Set 1C772

m. Align lube tee (20) to the damper bearing and secure it as follows:

(1) Install aligning gauge fixture 1C771 through the hole in the shield assembly. Aligning pin fits over tee fitting and aligns the tee. Torque fittings at both ends of tee. Refer to Section VIII, Reference No. 194 for torque value.

n. Install the damper bearing oil jet (21) and gasket to tee. Refer to Section VIII, Reference No. 194 for torque value.

o. Check the oil jet alignment using 1C771 gauge. This gauge fits over oil jet and has a pointer which indicates the alignment of oil jet. The pointer should point to tips of rollers (figure 5-64). Lockwire the 3 nuts on oil tee together.

p. Install the forward oil shield assembly (2) to turbine frame (figure 5-65). Secure with 14 screws and washers. Refer to Section VIII, Reference No. 189 for torque value. Lockwire in groups of 2.

q. Install the No. 2 bearing oil jet (15) and bracket (1) to the turbine frame. Secure with 2 bolts and washers, but do not torque. (See figure 5-66.)

r. Install the No. 4 bearing retainer ring (36) and seal assembly (40) to No. 4 bearing housing (30) as follows:

(1) Install the retainer ring (36) and secure with 8 bolts. Refer to Section VIII, Reference No. 198 for torque value. Lockwire in groups of 4.

(2) Install the No. 4 bearing seal assembly (40) and gasket (39). Secure with 20 screws and washers. Torque the screws in diametrically opposite planes until all screws have been torqued to 100-110 pound-inches to make certain that the seal and gasket are properly seated. With not more than one screw loosened at any one time, loosen and retorque the screws to the value given in Section VIII (Reference No. 199). Lockwire in groups of 4 (figure 5-67).

s. Install 8 anchor nut plates (29) to the forward side of the turbine frame aft flange. (See figure 5-68.)

(1) Secure anchor nut plates to the turbine frame using 16 screws.

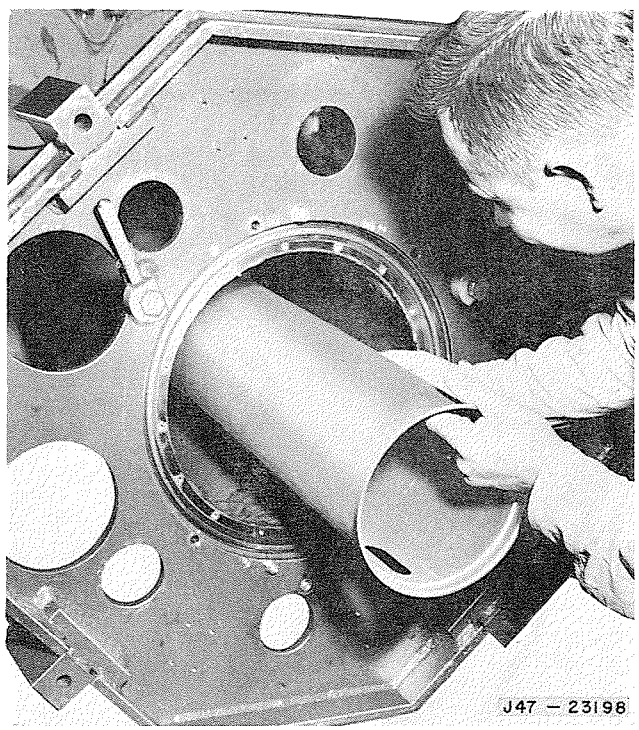
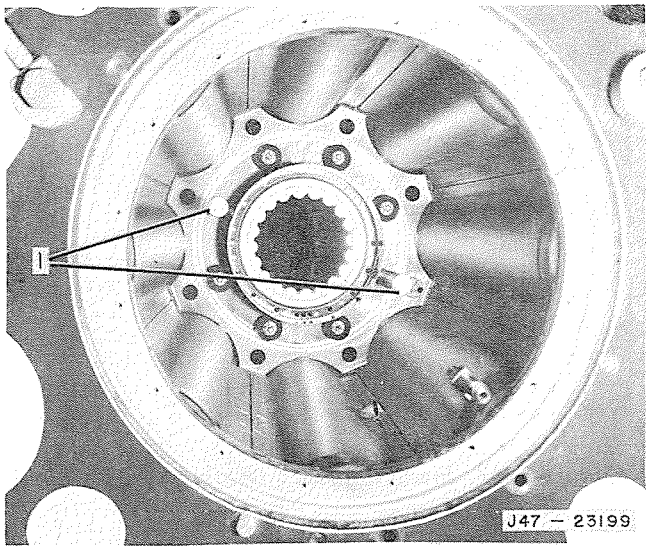


Figure 5-62. Installing Rear Oil Shield



1. Guide Pins (Locally Manufactured)

Figure 5–63. Installing No. 3 Bearing Assembly Using Locally Manufactured Guide Pins

Note

Tighten anchor plate screws enough to set screw heads into recess, thereby preventing interference between screw head and turbine nozzle mounting flange. However, the anchor plate must be loose enough to shift for centering turbine nozzle mounting bolts.

(2) Turn turbine frame assembly in stand so that aft end is up.

t. Installing Standard Transition Liners. Install 8 transition liners (31) into ports on turbine frame. Tap lightly into ports using plastic mallet if necessary. (See figure 5–69 and 5–70.

u. Assembly of annular transition liners.

(1) Install 8 transition liners (48) in place on the turbine frame. Secure the transition liners to the turbine frame brackets using 16 bolts and self-locking nuts, and 32 washers. Refer to Section VIII, Reference No. 180 for torque value.

Note

During assembly the transition liners must be evenly spaced around the circumference of the turbine frame.

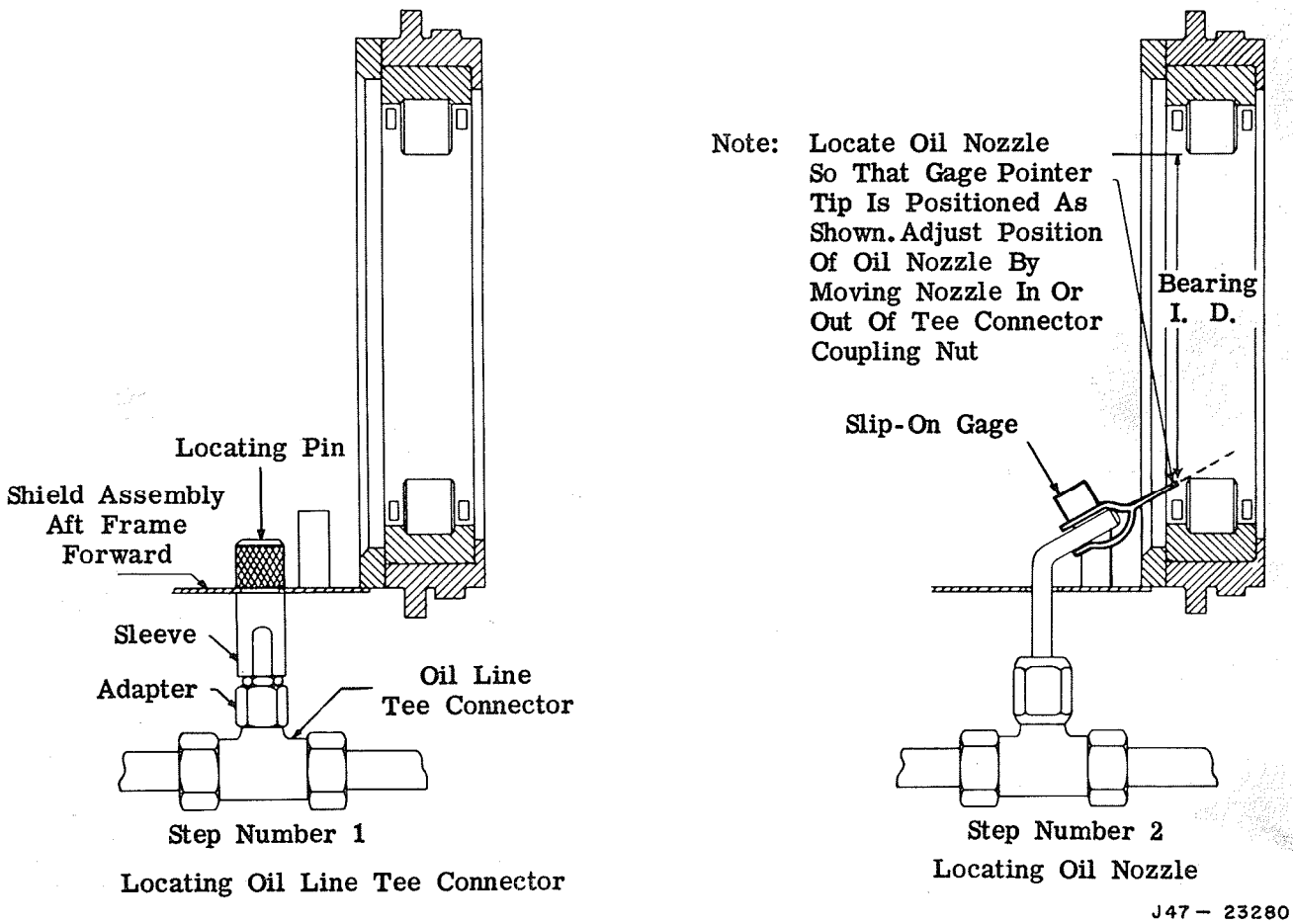

Locating Pin
Shield Assembly Aft Frame Forward
Sleeve
Adapter
Oil Line Tee Connector
Step Number 1
Locating Oil Line Tee Connector
Note: Locate Oil Nozzle So That Gage Pointer Tip Is Positioned As Shown. Adjust Position Of Oil Nozzle By Moving Nozzle In Or Out Of Tee Connector Coupling Nut
Bearing I. D.
Slip-On Gage
Step Number 2
Locating Oil Nozzle
J47 – 23280

Figure 5–64. Aligning No. 3 Bearing Oil Jet, Tool No. 1C771

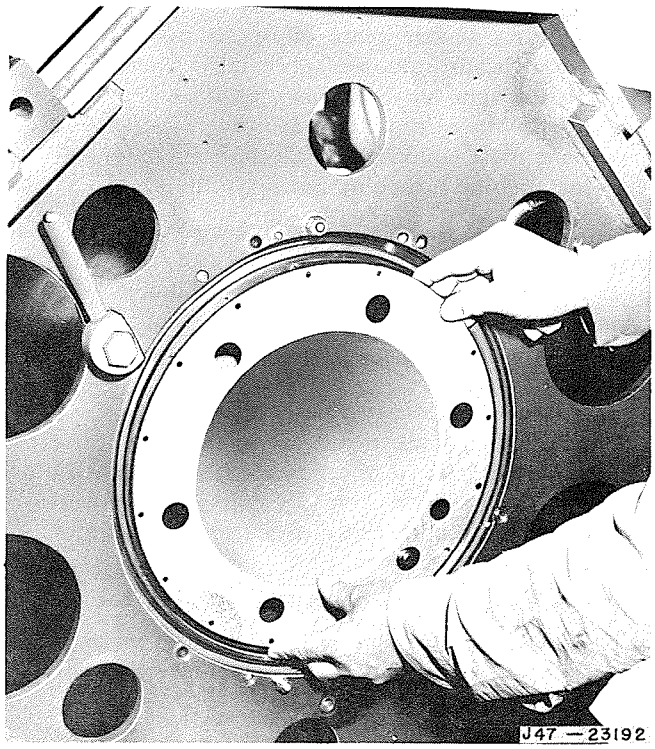


Figure 5–65. Installing the Forward Oil Shield

(2) Install the inner band (47) to the transition liner, securing with 16 bolts and washers. (See figure 5–71.) Refer to Section VIII, Reference No. 179 for torque value.

(3) Install the outer band (46) to the turbine casing retaining flange. Secure with 32 screws and washers. Refer to Section VIII, Reference No. 181 for torque value.

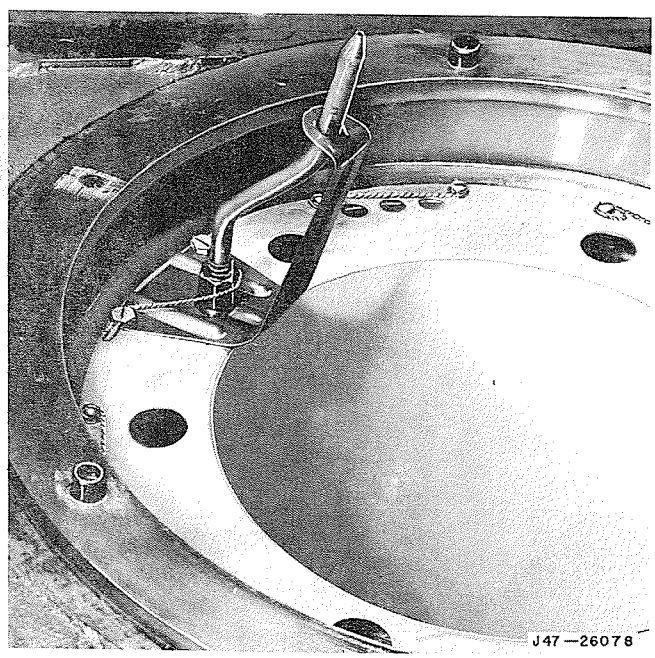


Figure 5–66. No. 2 Bearing Oil Jet and Bracket Installed

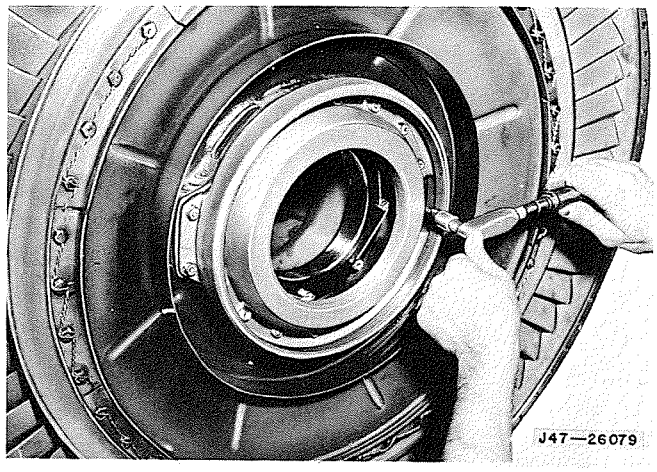


Figure 5–67. Installing No. 4 Bearing Seal Assembly

v. Install turbine casing assembly.

(1) Install the turbine casing assembly (41) to the turbine frame. Make certain that the drain port is located at the bottom (figure 5–72).

Note

Alignment of the turbine casing to the turbine frame can be checked by viewing twelfth stage cooling air-line groove.

(2) Install bolts equally spaced to the turbine casing and the turbine frame mounting flanges. Nuts are not used during this operation.

(3) If standard transition liners are used, connect transition liners to mounting flange located in turbine

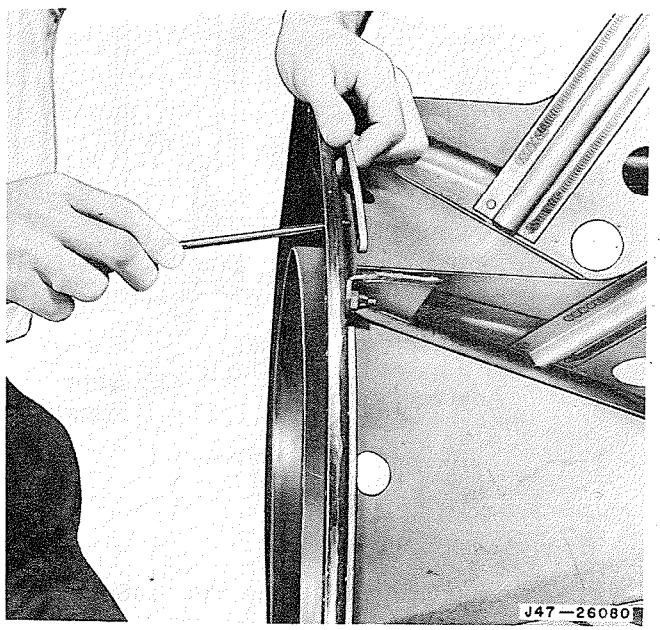


Figure 5–68. Installing Turbine Nozzle Anchor Nuts to Turbine Frame

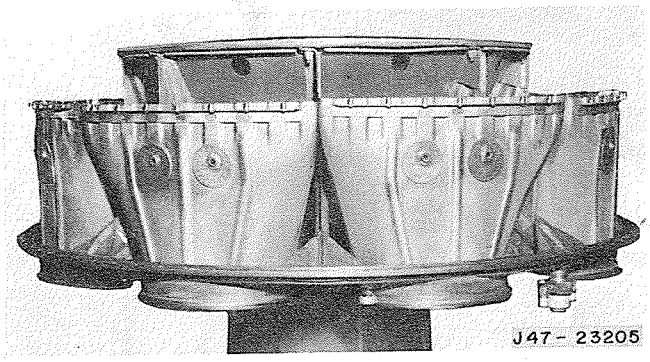


Figure 5-69. Installing Standard Transition Liners

casing. (See figure 5-73.) The pins (52) of the transition liners are inserted through holes in the mounting flange.

(4) Insert the locking wire through 3 pins of one transition liner and to 4 pins in adjacent liner. Insert locking wire in all transition liners.

(5) Secure the turbine casing (41) to the turbine frame using 80 bolts and self-locking nuts. Refer to Section VIII, Reference No. 186 for torque value.

Note

The transition liners and turbine casing may be slightly warped and it is good practice to first lock transition liners to turbine casing and then secure turbine casing to turbine frame.

(6) Install the twelfth stage cooling air clamp to the turbine casing (figure 5-74).

w. Install the turbine nozzle (42) to turbine frame as follows:

Note

The symbol "T" marked on each turbine nozzle is not necessarily used as a reference point for locating nozzle on turbine frame, but is used as a reference point in the inspection and measurement of throat area only.

(1) Apply anti-seize compound (Crane, Anti-Seize 425, or equivalent), to turbine nozzle mounting flange making certain that bolt holes are thoroughly covered.

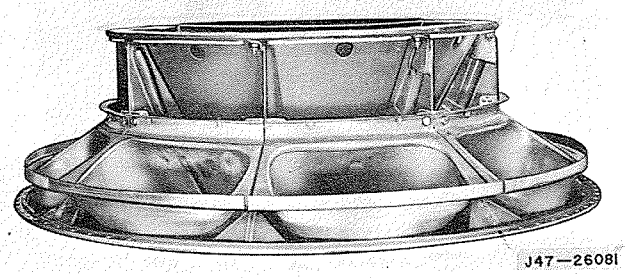


Figure 5-70. Annular Transition Liners Installed on Turbine Frame

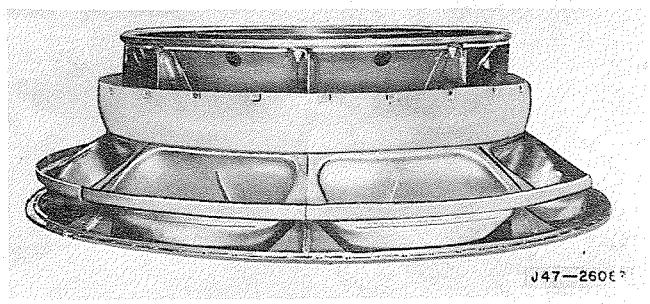


Figure 5-71. Inner Band and Annular Transition Liners Installed on Turbine Frame

Note

When inserted through bolt holes, the bolts will receive an ample amount of compound.

(2) Install 10 air deflectors (43) to the rear face of the nozzle diaphragm mounting flange (figure 5-75).

(3) Install 40 new bolts to secure the turbine nozzle and 10 air deflectors to the turbine frame. Refer to reference No. 200 for torque value.

Note

Torque the bolts in diametrically opposite planes until all bolts have been torqued to double the value given in Section VIII, Reference No. 200 to make certain turbine nozzle is properly seated. Not having more than one bolt loosened at any one time, loosen and retorque all bolts to value given in Section VIII, Reference No. 200. If the turbine nozzle does not seat properly after the bolts have been torqued, check for indications of a warped turbine nozzle mounting flange or warped mounting flange on turbine frame. Also check to see if turbine nozzle is binding against transition liners. New bolts should be used for securing turbine nozzle to tubine frame due to possibility of breaking old bolts during over-torque condition.

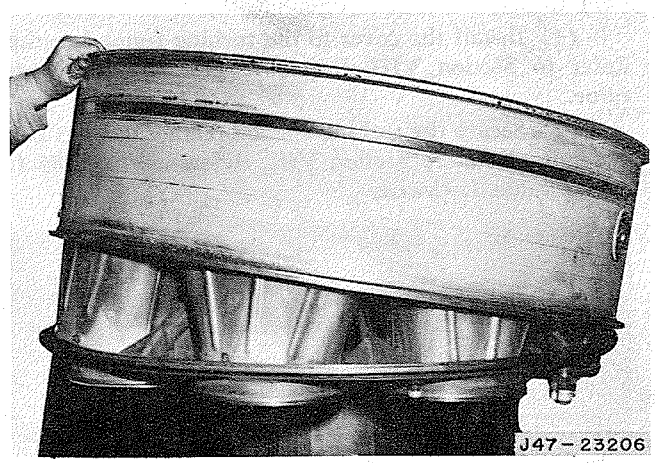


Figure 5-72. Installing Turbine Casing

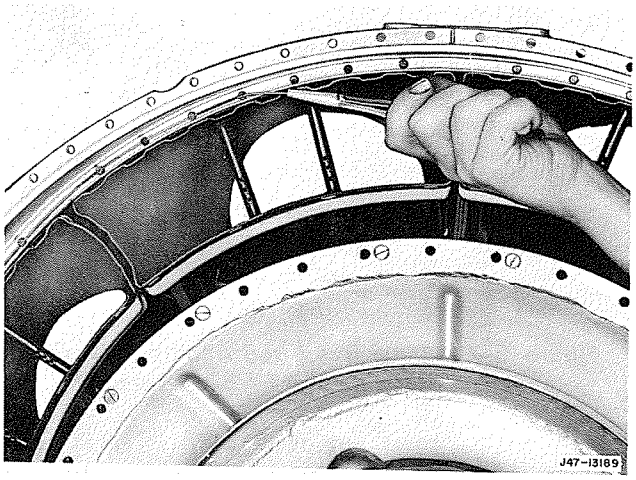


Figure 5–73. Securing Standard Transition Liners to Turbine Casing Using Locking Wires

(4) Lockwire bolts in groups of four with 0.041 heat and corrosion resistant wire. Start the second and following groups of four from the No. 4 bolt in the preceding group. Lockwire the No. 4 of the last group to the No. 1 bolt of the first group.

(5) Nozzle diagram attaching bolts will not be retorqued after engine operation.

x. Install connector tee (45) and gasket (44) to 6 o'clock position on turbine casing as follows:

(1) Install fittings to tee connector.

(2) Secure connector to the turbine casing using 4 screws. Refer to Section VIII, Reference No. 183 for torque value. Lockwire.

Note

The gasket will occasionally shrink after (engine) cell operation. Retorque screws before installing engine into aircraft to make certain proper torque value is maintained on the connector.

y. Install the turbine frame breather (28) and gasket (27) to turbine frame (figure 5–76) as follows:

(1) Install the cover to the turbine frame breather. Refer to Section VIII, Reference No. 185 for torque value.

(2) Secure the turbine frame breather using 3 bolts and nuts. Refer to Section VIII, Reference No. 185 for torque value. Lockwire.

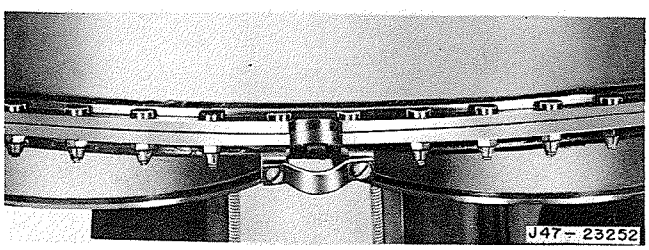


Figure 5–74. Twelfth Stage Cooling Air Clamp Installed

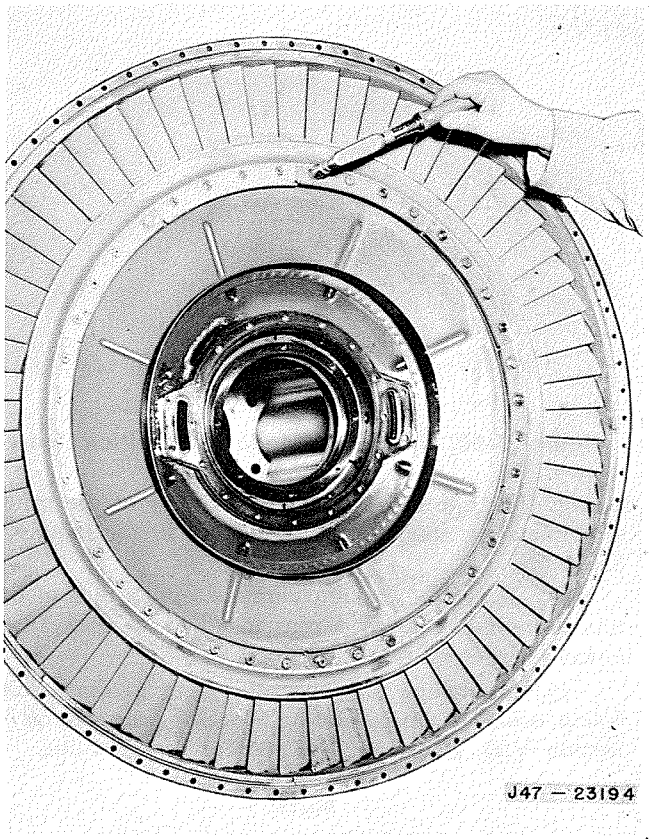


Figure 5–75. Installing Turbine Nozzle and Air Deflectors

Note

Cover turbine frame breather with a suitable cover or masking tape when a cover is not available.

z. Install eighth stage cooling air bellows (26) and gasket (25) to turbine frame. (See figure 5–77.)

(1) Secure with 3 bolts. Refer to Section VIII, Reference No. 184 for torque value. Lockwire.

Note

Insert bolts through turbine mounting flange and thread into bellows. (See figure 5–78.)

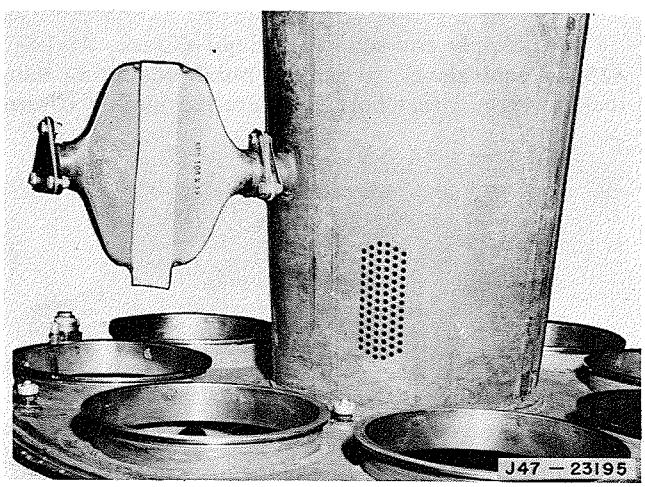


Figure 5–76. Turbine Frame Breather Installed

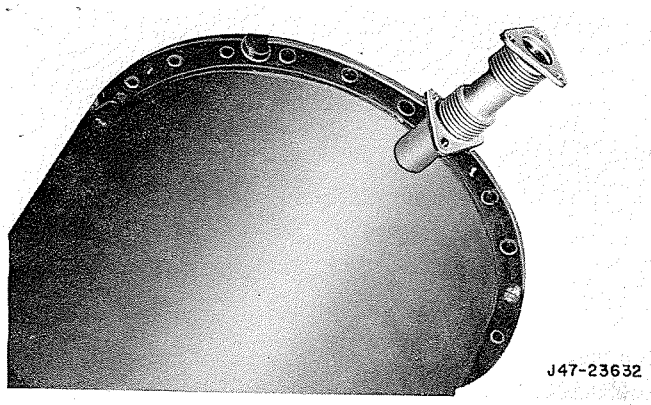


Figure 5-77. Eighth Stage Cooling Air Bellows Installed

5-41. BUILD UP OF THE TURBINE ROTOR.

NOTE

Throughout this paragraph the numbers in parentheses refer to figure 5-83 except where stated otherwise. For special tools see Section II, group 42.

a. Place the turbine rotor (11) in a vertical position on a pallet or suspend it from a hoist horizontally using lift 1C980. (See figure 5-79 and 5-80.)

b. Place the No. 4 bearing spacer (10), No. 4 bearing inner race (9), No. 3 bearing inner race (4) and shoulder ring (5) into a hot oil bath and heat to approximately 121°C (250°F). Use oil, Specification MIL-O-6081A, grade 1010, or equivalent.

c. Install the No. 4 bearing spacer (10) over the shaft against the forward face of the turbine wheel.

NOTE

Spacer should turn freely on shaft when properly installed.

d. Install the No. 4 bearing inner race (9) to the shaft solidly against the bearing spacer.

e. Align the lock washer (8) with inner tab in milled slot on shaft. Install No. 4 bearing lock nut (7). Use anti-seize compound, Specification MIL-L-25681 on threads.

f. Torque the No. 4 bearing locknut to value in Section VIII, Reference No. 203, using wrench 1C667 (figure 5-81).

NOTE

Allow spacer and inner race to cool before torquing.

NOTE

To assure that No. 4 bearing inner race is properly seated against turbine rotor bearing spacers, attempt to twist the spacer by hand after torquing locknut. Spacer should not turn on rotor shaft.

g. Assemble both halves of the split ring (6) in the groove in the turbine rotor shaft.

h. Install the shoulder ring (5) so that the split ring is contained in the cutout of the shoulder ring.

i. Install the No. 3 bearing inner race (4) against the face of the shoulder ring.

j. Install the No. 3 bearing nut (1). Use anti-seize compound Specification MIL-L-25681 on threads.

NOTE

Allow heated parts to cool before torquing.

k. Bend the aligned tab of lockwasher into cutout on No. 4 bearing locknut.

l. Torque No. 3 bearing locknut referring to Section VIII, Reference No. 204 for torque value, with No. 3 bearing locknut wrench 1C668. (See figure 5-82.)

NOTE

To assure that the No. 3 bearing inner race is properly seated against the shoulder ring, attempt to twist shoulder ring by hand after torquing. Shoulder ring should not turn on rotor shaft.

m. Install a copper thread protector plug (2) into each of the threaded holes in the No. 3 bearing nut.

n. Install a new set screw (3) to each of the threaded holes in the No. 3 bearing nut. Refer to Section VIII, Reference No. 205 for torque value.

o. Using a center punch, carefully lock set screws by peening the top surface metal of each set screw, at 2 positions into threads of nut. Do not allow punch to damage threads in nut. (See figure 5-83.)

5-42. DELETED.

5-43. DELETED.

5-44. DELETED.

1. Bracket
2. Forward Oil Shield Assembly
3. Cotter Pins
4. Nut
5. Washer
6. Guide
7. Ring Assembly
8. Springs
9. Guide
10. Bearing Outer Race and Roller Assembly
11. Bearing Housing
12. Stud
13. Nut
14. Rear Oil Shield Assembly
15. No. 2 Bearing Oil Jet
16. Tube Assembly
17. Clip Assembly
18. Nut
19. Packing
20. Lube Oil Tee
21. Damper Bearing Oil Jet
22. Packing
23. Nut
24. Turbine Frame
25. Gasket
26. Eighth Stage Cooling Air Bellows
27. Gasket
28. Turbine Frame Breather
29. Anchor Nut Plates
30. No. 4 Bearing Housing
31. Transition Lines
32. Clamp
33. No. 4 Bearing Oil Jet Bracket
34. No. 4 Bearing Outer Race
35. Grommet
36. Retainer Ring
37. No. 4 Bearing Lube Oil Tube Assembly
38. Clamp
39. Gasket
40. Seal Assembly
41. Turbine Casing Assembly
42. Turbine Nozzle
43. Air Deflectors
44. Gasket
45. Connector Tee
46. Outer Band
47. Inner Band
48. Transition Liners
49. Tube Cover
50. Gasket
51. Cap
52. Pins (Transition Liner)

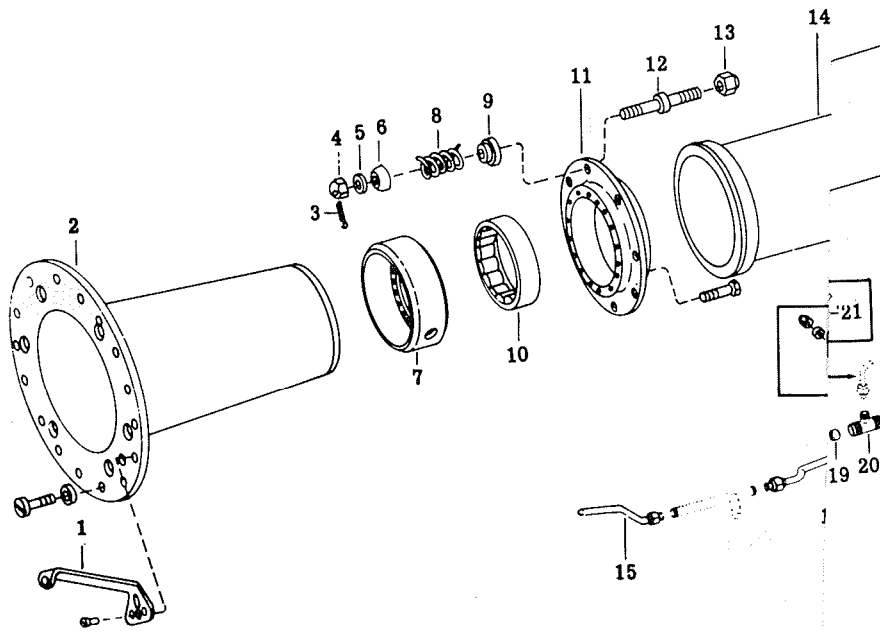


Figure 5–78. Exploded View Turbine Frame

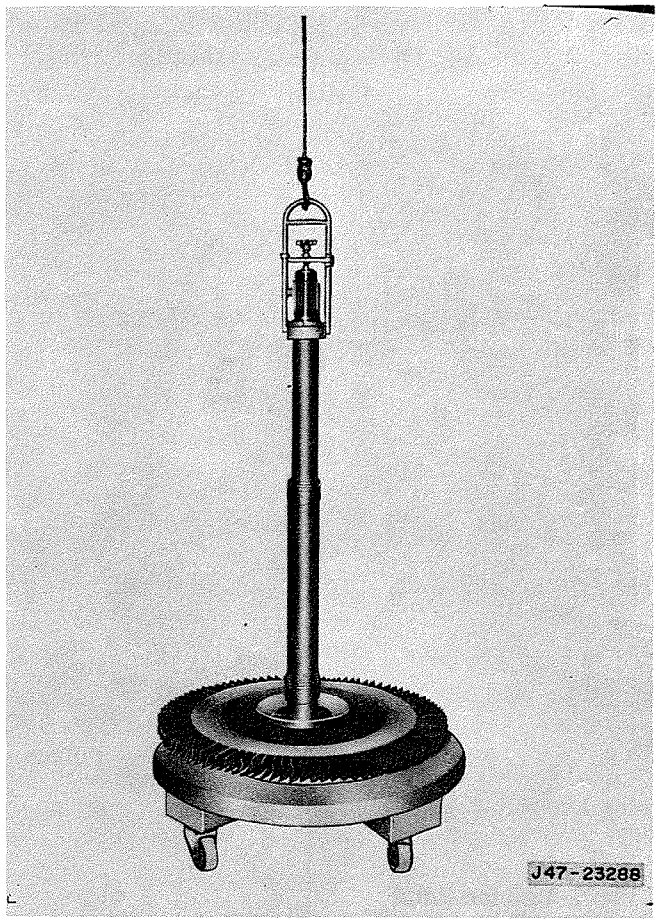


Figure 5–79. Turbine Rotor on Pallet

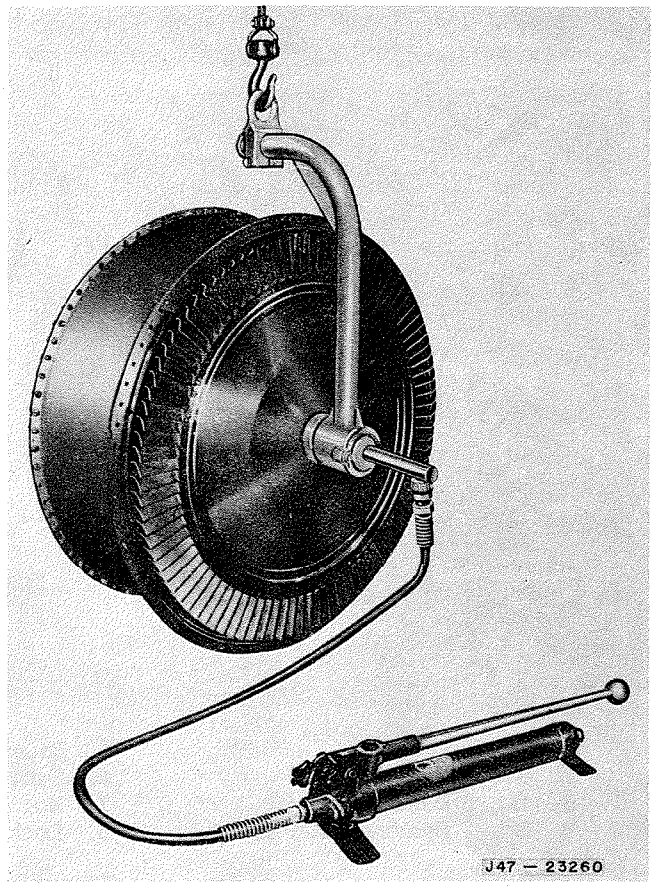


Figure 5–80. Turbine Rotor Suspended Using 1C980

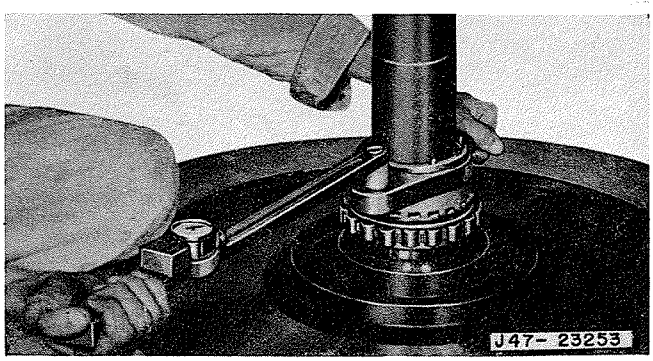


Figure 5–81. Torquing No. 4 Bearing Locknut Using 1C667

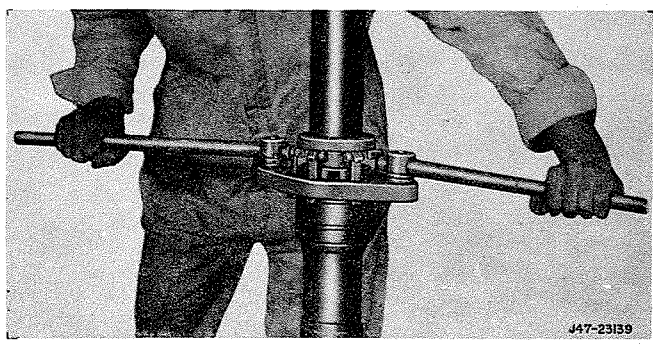
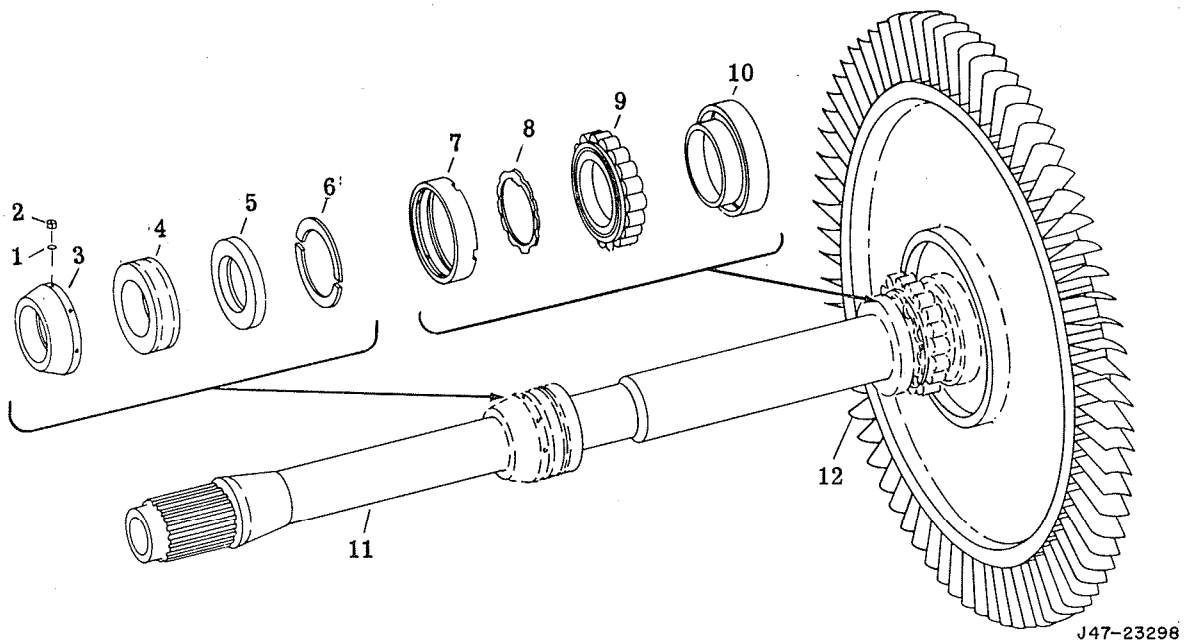


Figure 5–82. Torquing No. 3 Bearing Locknut Using 1C668



1. Protector Plug
2. Set Screw
3. No. 3 Bearing Nut
4. No. 3 Bearing Inner Race
5. Shoulder Ring
6. Split Ring
7. No. 4 Bearing Locknut
8. Lock Washer
9. No. 4 Bearing Inner Race
10. No. 4 Bearing Spacer
11. Turbine Rotor

Figure 5-83. Exploded View, Turbine Rotor

Figure 5-84. Deleted

SECTION VI
FINAL ASSEMBLY

6-1. GENERAL.

6-2. The instructions and precautions called out in paragraph 5-2 through 5-5 apply to final assembly also.

6-3. HORIZONTAL ASSEMBLY.

6-4. ASSEMBLY OF THE TURBINE SECTION.

6-5. INSTALLING TURBINE ROTOR INTO TURBINE FRAME.

Note

For special tools, see Section II group 44.

a. With the rotor in transportation stand 1C982 (figure 6-1), screw lift 1C980 (figure 6-2) on to the hub of the turbine rotor. (See figure 6-2.)

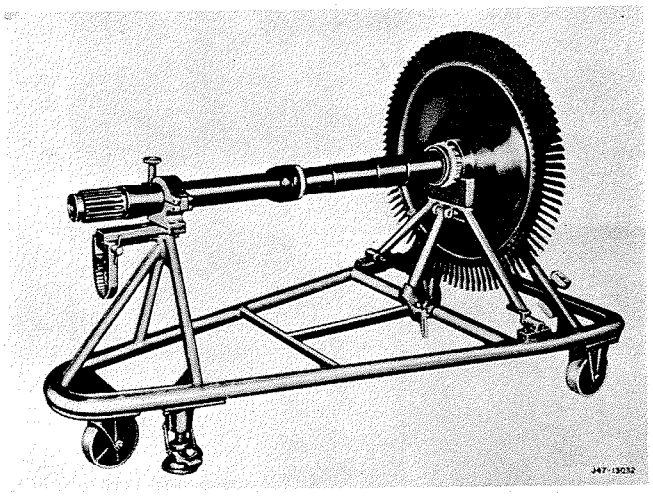


Figure 6-1. Turbine Rotor Installed in Stand 1C982

b. Attach an overhead hoist to the turbine rotor lift and remove the rotor from the stand.

c. Coat the turbine rotor shaft with oil, Specification MIL-O-6081.

d. Pack the No. 3 and 4 bearings with petrolatum MIL-VV-P-236 to prevent them from causing interference during installation of the rotor to the turbine frame.

e. Turn turbine frame into the horizontal position in stand 1C632M.

f. Slide the turbine rotor into the turbine frame.

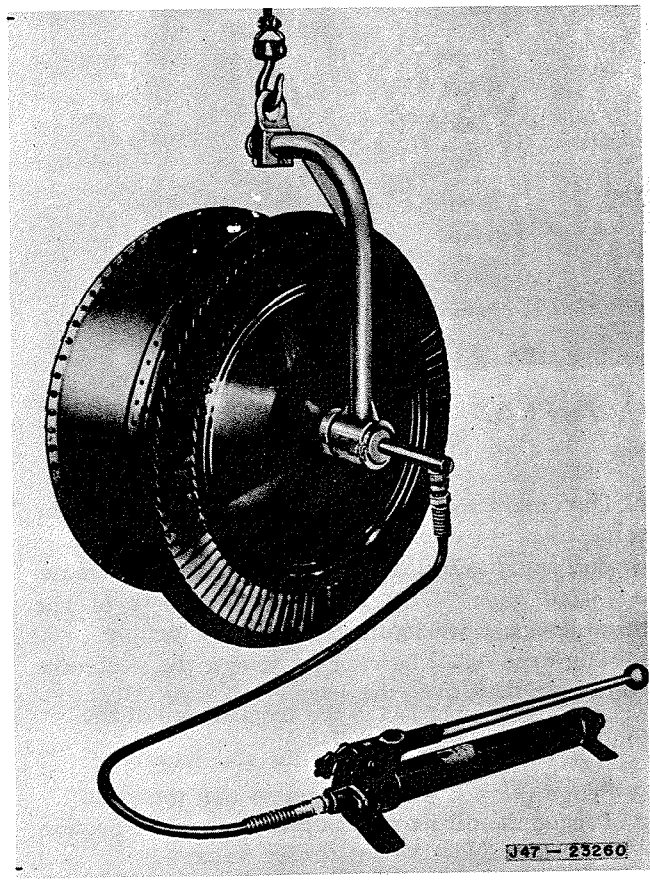


Figure 6-2. Installing Turbine Rotor Using Lift 1C980

CAUTION

Use care not to strike the seals or bearings when installing the turbine rotor.

g. Install turbine rotor holding clamp 1C883 (figure 6-3) to secure the turbine rotor to the turbine frame.

h. Remove lift 1C980 from the turbine rotor hub.

6-6. INSTALLING TURBINE SECTION TO COMPRESSOR REAR FRAME.

Note

For special tools, see Section II, group 38.

a. With the turbine frame in a horizontal position in stand 1C632, install sling 1C896 to the turbine frame and the turbine casing. (See figure 6-4.)

b. Attach an overhead hoist to sling 1C896.

o. Install the turbine rotor holding adapter 1C2036 (1, figure 6-8) around the turbine rotor hub.

Note

Wrench 1C695 (1, figure 6-9) may be used if adapter 1C2036 is not available.

p. Thread driver 1C2039 (2, figure 6-8) onto the turbine tie-bolt far enough to insert a pin through the drilled hole in the driver and through the cotter pin hole on the tie-bolt. Tighten the left hand threaded bolt of the driver snug against the tie-bolt. Place a wrench on the body of the driver and torque. Refer to Section VIII, Reference No. 201 for torque value.

Note

Adapter 1C985 (3, figure 6-9) may be used if driver 1C2039 is not available. Thread the adapter onto the tie-bolt using the hand wrench. Install a torque wrench into the opening in the center of the adapter and torque. Refer to Section VIII, Reference No. 201 for torque value.

q. Coat the rear threads of the turbine tie-bolt with high-temperature anti-seize compound. (Cranes 425; Chicago, Illinois.)

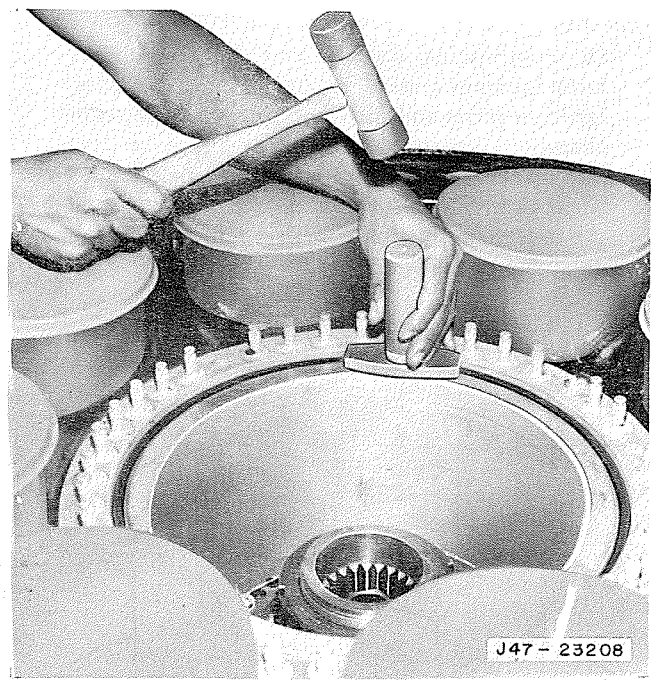


Figure 6-6. Seating Turbine Frame "O" Ring Seal in Compressor Rear Frame Using a Locally Manufactured Pusher

r. Install a tabwasher and nut on the tie-bolt and torque. Refer to Section VIII, Reference No. 202 for torque value. Loosen and retorque to minimum value. If cotter pin holes are not aligned, continue torquing until holes are aligned. Do not exceed maximum value. Bend ears of tabwasher onto the flats of the turbine tie-bolt nut. (See figure 6-10.)

Note

Bend cotter pin around tie-bolt nut.

s. Install the scavenge pump with gasket to the compressor rear frame and secure with 3 bolts and washers. Refer to Section VIII, Reference No. 158 for torque value. Lockwire.

Note

Make sure the splined coupling joins the scavenge pump to the scavenge gear train and that a retaining ring is installed at each end of the coupling in the provided internal machined recesses.

t. Install the scavenge pump finger-screen with a gasket and the turbine frame oil drain tube with a gasket to the mounting flange on the turbine frame. Secure with 4 bolts and washers and torque. Refer to Section VIII, Reference No. 183 for torque value.

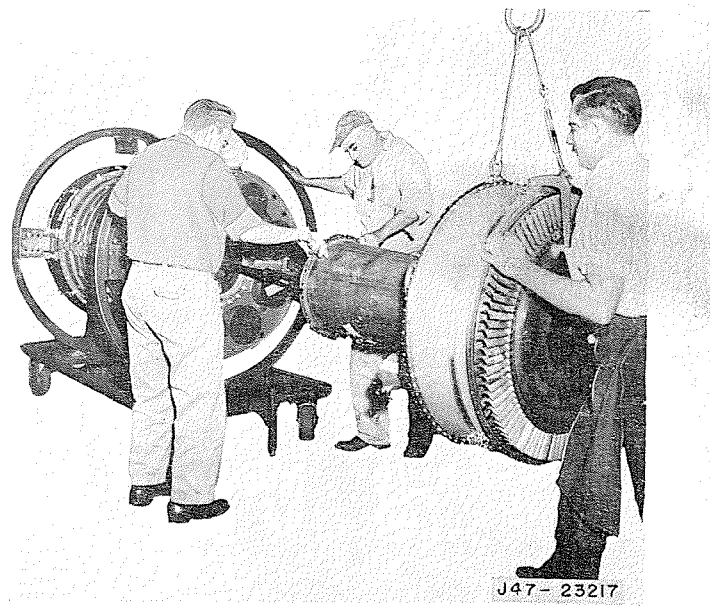


Figure 6-7. Installing Turbine Frame to Compressor Rear Frame

u. Connect the nut end of the turbine frame oil drain tube to the union on the oil scavenge pump. Refer to Section VIII, table XLI for torque value.

6–7. ASSEMBLY OF COMBUSTION SECTION.

6–8. INSTALLING COMBUSTION CHAMBERS AND DRAIN LINES.

Note

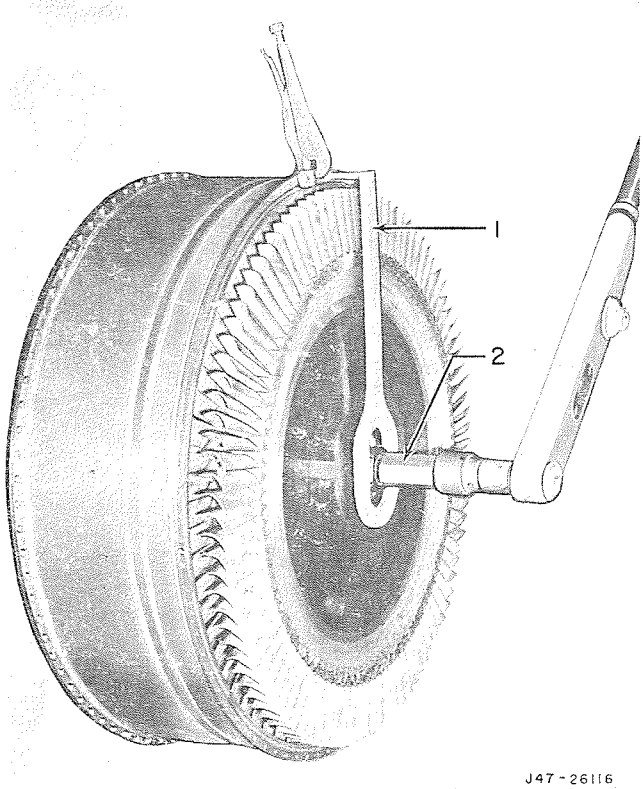
For special tools, see Section II, group 4.

a. Remove the protective covers (locally manufactured) from the compressor rear frame and the turbine frame combustion chamber flanges.

b. Install the combustion chambers in the following order, using compression clamp 1C988 (figure 6–11) and expansion clamp 1C989 (figure 6–12). When the chambers are in position on the engine, hold them in place with Marmon clamps on the front and rear flanges, but do not torque the clamps. Lever 1C2227 (figure 6–13) can be used to connect the Marmon clamp clips.

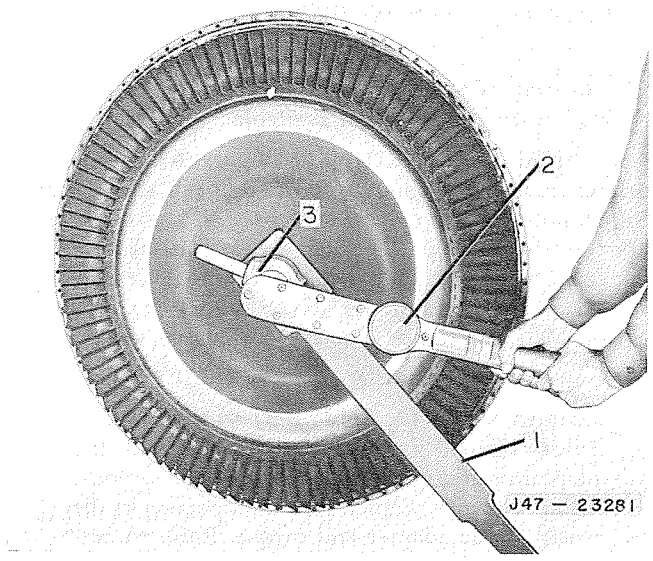
(1) Install combustion chambers Nos. 1 and 8. Connect the drain lines and torque. Refer to Section VIII, table XLI for torque value.

(2) Install combustion chambers Nos. 2 and 7. Connect the drain lines and torque. Refer to Section VIII, table XLI for torque value.



1. Adapter 1C2036 2. Driver 1C2039

Figure 6–8. Torquing Turbine Tie-bolt Using Driver 1C2039



1. Wrench 1C695 2. Torque Wrench 3. Adapter 1C985

Figure 6–9. Torquing Turbine Tie-bolt Using Adapter 1C985

Note

On combustion chambers with the bellows cross-ignition system, reach through the cross-ignition ports and move the inner combustion chamber forward to prevent interference during installation. After the combustion chamber is properly positioned on the engine, move the inner combustion chamber rearward to engage the transition liner.

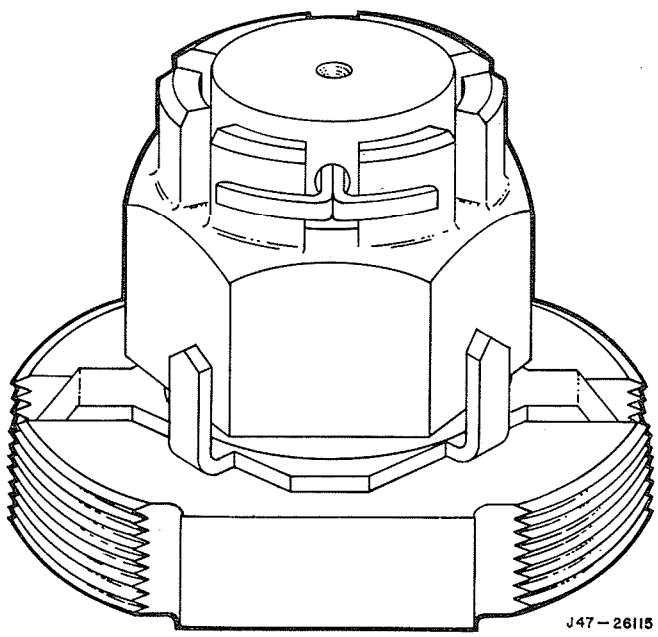


Figure 6–10. Turbine Tie-bolt Nut Properly Safetied

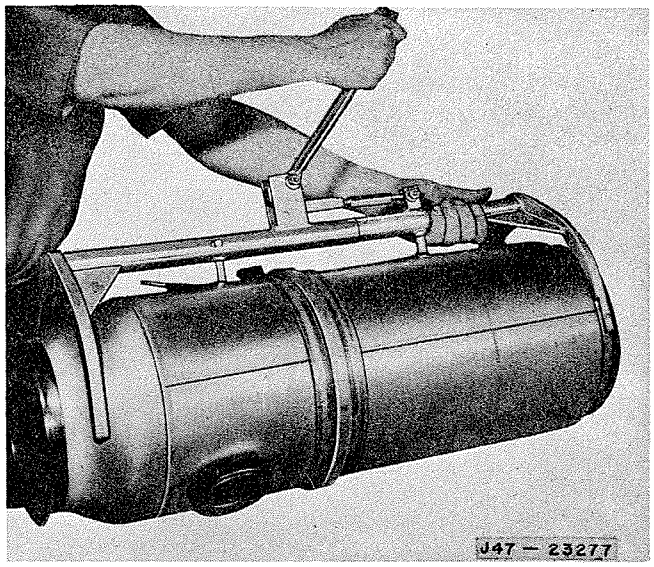


Figure 6-11. Installing Combustion Chambers with Clamp 1C988

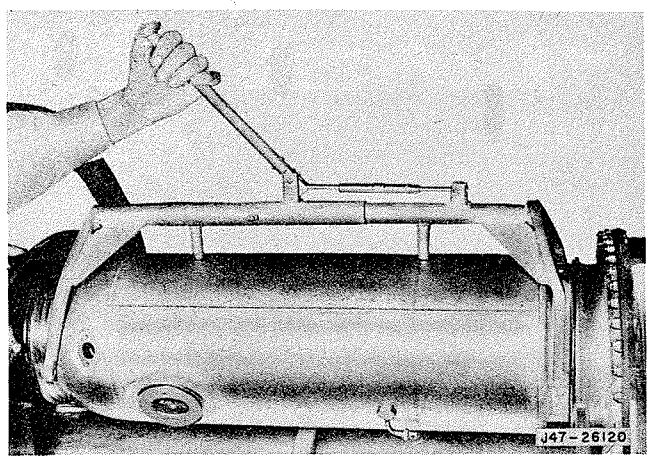


Figure 6-12. Installing Combustion Chambers with Clamp 1C989

NOTE

There are no forward drain lines on Nos. 2 and 7 combustion chambers with the elliptical cross-ignition system.

(3) Install combustion chambers Nos. 3 and 6. Connect the drain lines and torque. Refer to Section VIII, Table XLI for torque value.

NOTE

There are no forward drain lines on chambers No. 3 and 6 combustion chambers with the bellows cross-ignition system.

(4) Install the drain manifold and tee to the fitting on the turbine frame and torque. Refer to Section VIII, Tabel XLI for torque value.

(5) Install combustion chambers Nos. 4 and 5. Connect the drain lines and torque. Refer to Section VIII, Table XLI for torque value.

b. Install 8 fuel nozzles with gaskets. Secure each nozzle with 6 of the 8 bolts and torque. Refer to Section VIII, Reference No. 162 for torque value. Lockwire.

NOTE

Align the fuel nozzle with the port on the dome of the inner combustion chamber before bolting the nozzle in place.

c. Install the cross-ignition Marmon clamp on the elliptical cross-ignition system combustion chambers and torque the T-Bolt lock nuts. (Refer to Section VIII, Reference No. 173 for torque value.) Lockwire is not required.

d. Install the inner connectors, cross-ignition tubes, and gaskets on combustion chambers with bellows cross-ignition system. Secure in place with 6 screws and torque. Refer to Section VIII, Reference No. 171 for torque value. Lockwire.

e. Install a positioning bolt at the rear of each combustion chamber with bellows cross-ignition system and torque. Refer to Section VIII, Reference No. 176 for torque value. Lockwire.

f. Install the forward and rear Marmon clamps of each combustion chamber and torque the T-Bolt lock nuts. (Refer to Section VIII, Reference No. 174 for torque value.) Lockwire is not required. (See figure 6-14.)

g. Check for proper alignment between chambers by measuring the overlap of the flange through the slot in the Marmon clamps. Overlap of 1/16 of an inch is permissible on both the compressor rear frame flange and the turbine frame flange.

6-9. DELETED.

6-10. DELETED.

6-11. DELETED.

6–12. DELETED.

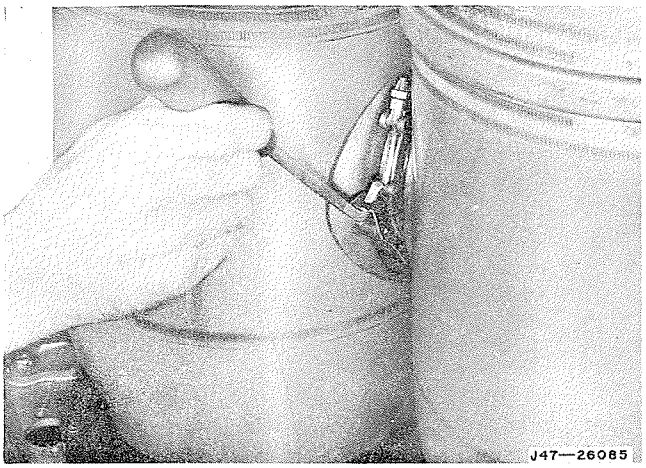


Figure 6–13. Connecting Marmon Clamp Clips with Lever 1C2227

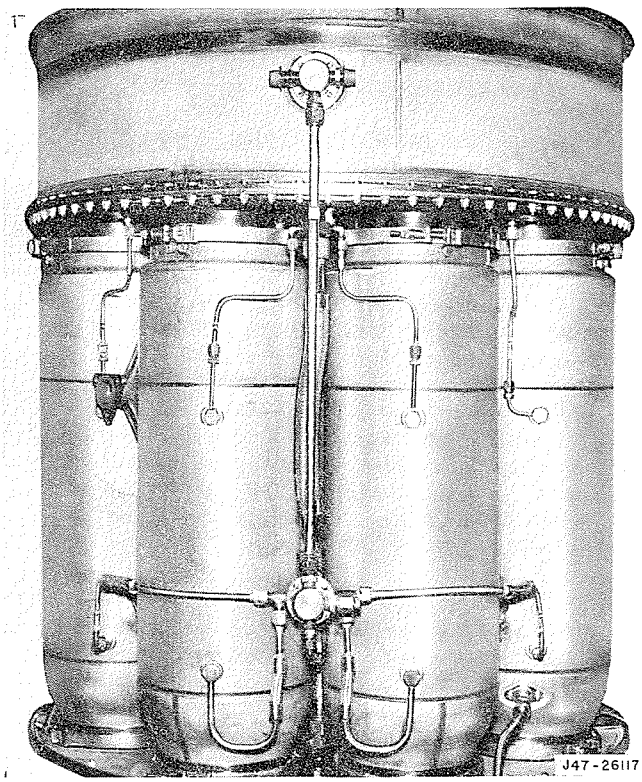
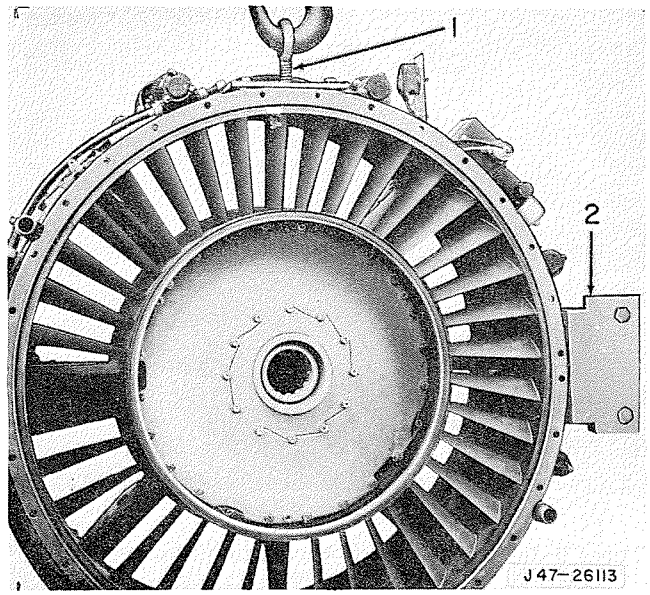
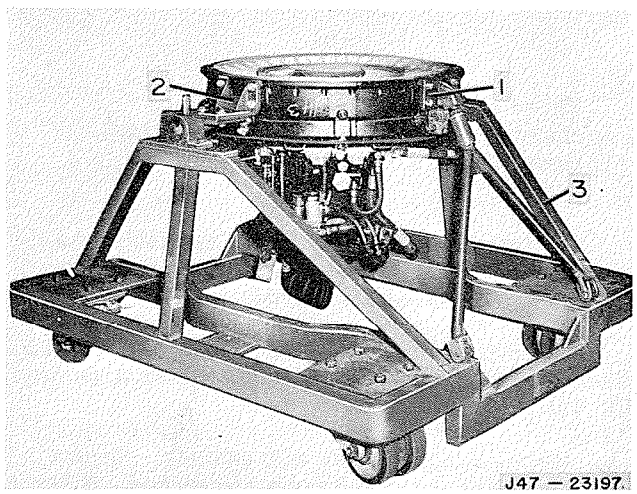


Figure 6–14. Combustion Chambers Installed



1. Eye Pad 1C645 2. Bracket 1C619–59

Figure 6–15. Eye Pad 1C645 Installed on Compressor Front Frame



1. Bracket 1C2153 2. Bracket 1C619–59 3. Stand 1C2030

Figure 6–16. Compressor Front Frame Installed in Assembly Stand 1C2030

6–13. DELETED.

Figure 6–17. Deleted

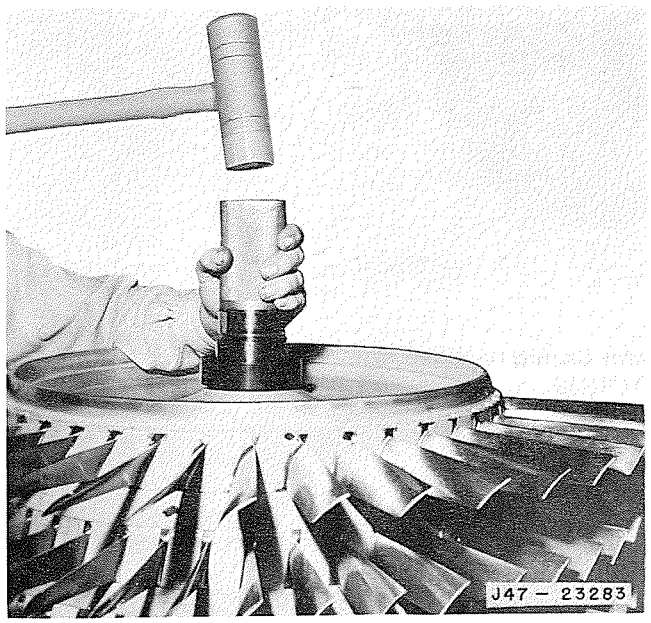


Figure 6–18. Installing No. 1 Bearing Oil Seal Hub and Inner Race Using Driver 1C789

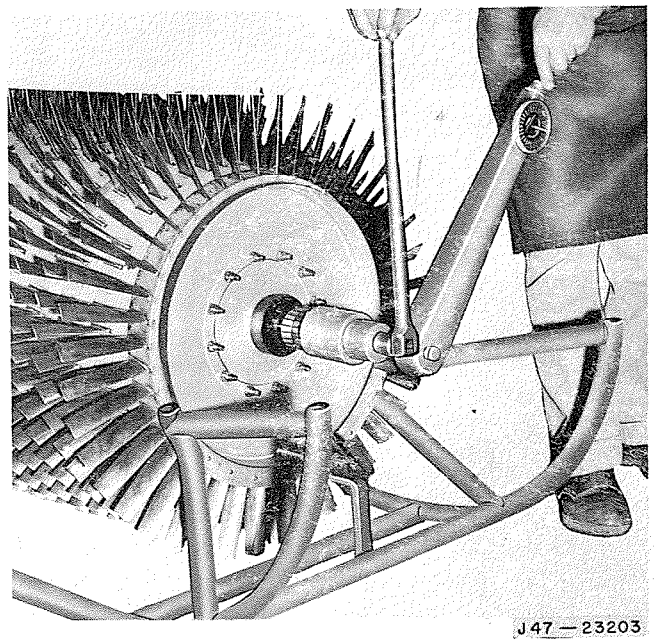


Figure 6–19. Torquing No. 1 Bearing Spanner Nut with Wrench 1C783

6–14. DELETED.

Figure 6–20. Deleted

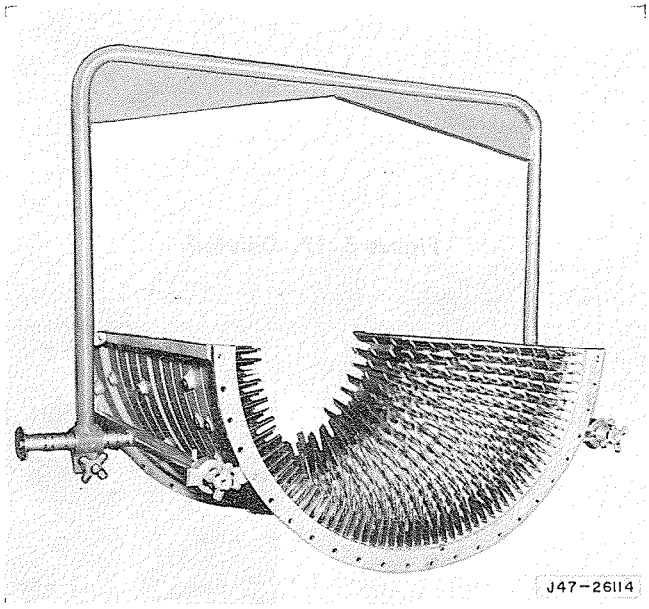


Figure 6–21. Compressor Stator Casing Installed in Lifting Sling 1C2025

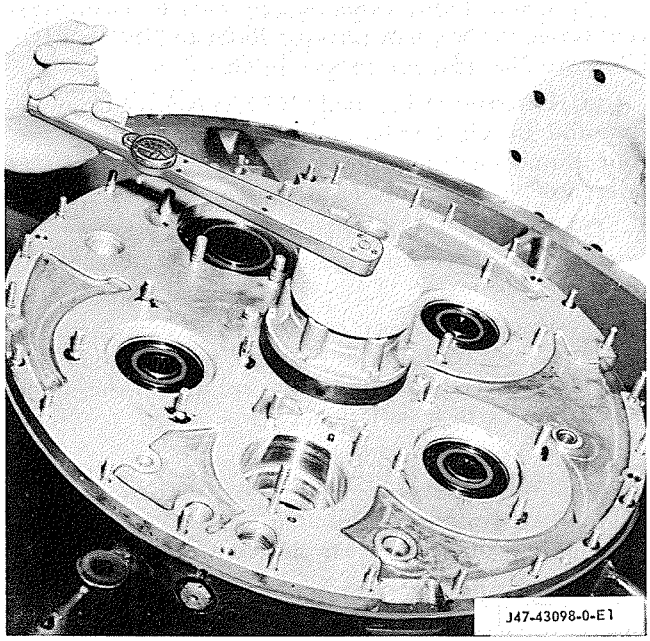


Figure 6–23. Torquing Cap Assembly Tool No. 1C908

6–15. INSTALLING COMPRESSOR FRONT FRAME TO COMPRESSOR SECTION.

WARNING

Before installing the compressor front frame, make sure that the No. 1 bearing inner race is matched to the outer race and rollers in the front frame; i.e., if the outer race and rollers have been replaced in the front frame, install the matched inner race on the compressor rotor shaft.

a. Install the No. 1 bearing inner race as follows:

(1) Coat the compressor front shaft with oil, Specification MIL–O–6081.

(2) Install the No. 1 bearing oil seal hub and inner race to the compressor front shaft, using driver, 1C789 (figure 6–18).

(3) Slide a tab-washer into the spanner nut and thread the spanner nut on to compressor rotor front shaft.

(4) Install wrench, 1C783 (figure 6–19), over the compressor front shaft so the pins on the body of the wrench fit into the pin holes on the spanner nut. The center section of the wrench engages the splines on the compressor shaft. Hold the rotor steady, using a hinge handle wrench on the center section of the wrench.

(5) Install a torque wrench to the ear on wrench, 1C783, and torque the No. 1 bearing spanner nut to the value given in Section VIII, Reference No. 157.

(6) Remove wrench, 1C783, and bend the tab-washer tab into the spanner nut slot. Install pilot, 1C2027, in the compressor front shaft.

b. Install the accessories, air inlet sectors, islands, and miscellaneous parts to the front frame in reverse order of removal, using instructions in paragraphs 5–9 through 5–19. Since the accessories were not completely disassembled and all miscellaneous parts were possibly not removed from the front frame, all the instructions in paragraphs 5–9 through 5–19 will not apply; therefore, use only those instructions that are necessary.

CAUTION

Lubricate both male and female splines with plasti-lube No. 3 stock number 9150–823–8045 or alternate silicon lubricant, stock No. 9150–754–2595. Be sure that all fittings and connections are properly torqued to specified limits.

c. Install the outer coupling on to the compressor front shaft by sliding it over pilot, 1C2027, so that the chamfered end of the coupling faces toward the compressor. Lubricate splines in coupling and on the rotor shaft as directed in above CAUTION.

d. Attach brackets, 1C619–59 and 1C810, to the front frame mounting pads at the 3 and 9 o'clock positions. (See figure 3–23 and paragraph 3–47d.) Attach sling, 1C808, to the lifting brackets, 1C810; lift the front frame and slowly lower it on to the compressor stator casings.

CAUTION

Use care to prevent damaging the No. 1 bearing, air and oil seals and mounting rabbet.

e. Install the bolts, washers, and nuts that secure the front frame to the stator casings. Refer to Section VIII, Reference No. 152, for torque value.

f. Transfer the engine back to the horizontal position, remove sling and lifting brackets, and install the bolts and washers at the front frame mounting pads. Refer to Section VIII, Reference No. 154, for torque value. Lockwire.

g. Remove pilot, 1C2027. Lubricate male and female splines on inner coupling, and install the inner coupling and lockring that holds the inner coupling in position. Install the cover plate and lockring that secures the cover plate.

h. If the cap assembly was disassembled, assemble and install as follows (figure 6–22):

(1) Install O-ring (18) on the inner circumference of cap (17).

(2) Install seal (20) into cap (17) by pressing seal into cap by hand. Use a suitable non-metallic pusher if necessary.

Note

The flat surface of the seal must be facing the head of the cap.

(3) Install O-ring (19) on the outer circumference of the cap (17); then thread the cap into the front bearing housing (51) and torque to 600 pound-inches, using tool, 1C908 (figure 6–23).

(4) Lockwire the cap assembly to the front bearing retaining bolts in groups of 2. Lockwire so the 2 bolts next to the starter-generator mounting pad are not wired together, since this will interfere with installation of the starter-generator.

i. If the front frame was removed in the horizontal position, installation will be in reverse order of removal.

(1) Attach lifting pad, 1C645, to the front frame mounting pad at the 12 o'clock position. Attach the 2 guide bars to the front frame mounting pads at the 3 and 9 o'clock positions. (Refer to paragraph 3–47e (4).)

(2) Attach a sling to the eye on lifting pad, 1C645, and with personnel holding the front frame in alignment with the 2 guide bars, install the front frame.

CAUTION

It is imperative that the front frame be held in perfect alignment to prevent damaging the No. 1 bearing, air and oil seals and mounting rabbet.

(3) Install bolts, washers, and nuts to secure the front frame to the stator casings. Refer to Section VIII, Reference No. 152, for torque value.

(4) Remove lifting pad, 1C645, and the 2 guide bars, and install 2 bolts and washers at each of the front frame mounting pads. Refer to Section VIII, Reference No. 154, for torque value. Lockwire.

(5) Remove pilot, 1C2027, and the shims that were installed between the first-stage rotor blade tips and stator casings.

(6) Install the inner coupling, the lockring that holds the inner coupling in position, and the accessory cap and/or cover plate. Lubricate splines on the inner coupling prior to installation.

Note

Use instructions in paragraph 5–7 through 5–17 as necessary for installation of accessories and miscellaneous parts to the front frame.

6–16. COMPRESSOR SECTION CLEARANCES.

6–17. CHECKING COMPRESSOR SECTION ROTATING CLEARANCES.

Note

For special tool, see Section II, group 13.

a. Install the spreader bar 1C2035–2 (3, figure 6–29) between assembly stand 1C2030 and the compressor rear frame.

b. Install platform 1C2035–3 (1, figure 6–29) to the compressor section so the top surface of the platform is even with the forward flange of the upper stator casing.

Figure 6–24. Deleted

Figure 6–25. Deleted

Figure 6–26. Deleted

Figure 6–27. Deleted

Figure 6–28. Deleted

c. Remove the nuts and bolts in the horizontal flange of the compressor stator casings.

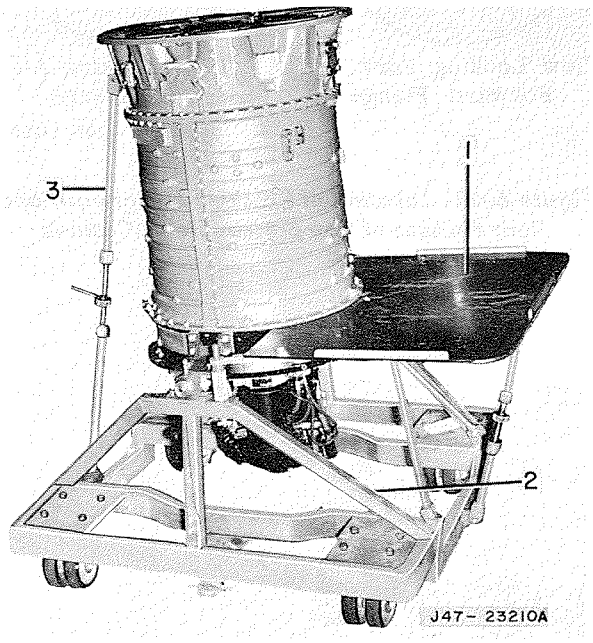
d. Remove all nuts, bolts, and washers in vertical flanges that secure the upper stator casing to the compressor front frame and to the compressor rear frame.

e. Slide the upper stator casing off the engine onto platform 1C2035–3.

f. Place a small piece of clay or beeswax on the high blade of each stage of the compressor rotor. (These blades were marked during overhaul of the compressor rotor.)

g. Place a small piece of clay or beeswax on the high spot of each compressor spacer. (These positions were marked during overhaul of the compressor rotor.)

h. Slide the upper stator casing off platform 1C2035–3 and onto the engine.



1. Platform 1C2035–3 2. Stand 1C2030
3. Spreader Bar 1C2035–2

Figure 6–29. Compressor Section Ready for Rotating Clearance Check

i. Install 3 bolts, nuts, and 6 washers, on each horizontal flange and torque. Refer to Section VIII, Reference No. 153 for torque value.

j. Rotate the compressor rotor one complete revolution.

k. Remove the nuts, bolts and washers on the horizontal flanges and slide the upper stator casing off the engine onto platform 1C2035–3.

l. Measure the thickness of the remaining clay on the high blade of each stage. This thickness will give the amount of clearance between the compressor stator casing and the high blade of each stage. Refer to Section VIII, Reference No. 6 for allowable clearance.

m. Measure the thickness of the remaining clay on the high spot of each compressor spacer. This thickness will give the amount of clearance between the compressor stator blades and the high spot of each rotor spacer. Refer to Section VIII, Reference No. 7 for allowable clearance.

n. Measure the clearance between the compressor rotor twelfth stage wheel and the air seal. (See figure 6–30.) Gage 1C831 can be used to check this clearance, or, a thickness gage may be used. Refer to Section VIII, Reference No. 8 for allowable clearance.

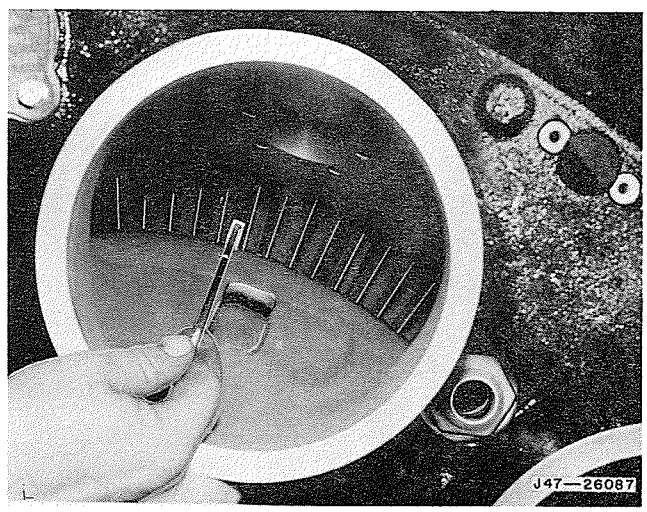


Figure 6–30. Checking Clearance Between 12th Stage Rotor Wheel and Air Seal Using Gage 1C831

o. Measure the clearance between the compressor rotor first stage wheel and the inlet guide vane using a thickness gage. Refer to Section VIII, Reference No. 2 for allowable clearance.

Note

If any of the clearances called for in steps "l" through "o" are not within allowable limits, the affected parts should be returned to overhaul.

p. Slide the upper stator casing off platform, 1C2035–3, and onto the engine. Install all the nuts, bolts and washers in the horizontal and vertical flanges. Apply torque alternately from the center outward. Refer to Section VIII, Reference No. 152, 153, and 154, for torque value. Lockwire stator casing to front frame and stator casing to rear frame bolts at the stator casing horizontal flanges.

Note

For the positioning of brackets on the vertical flanges of the compressor stator casings, see figure 6–31.

q. Remove platform 1C2035–3.

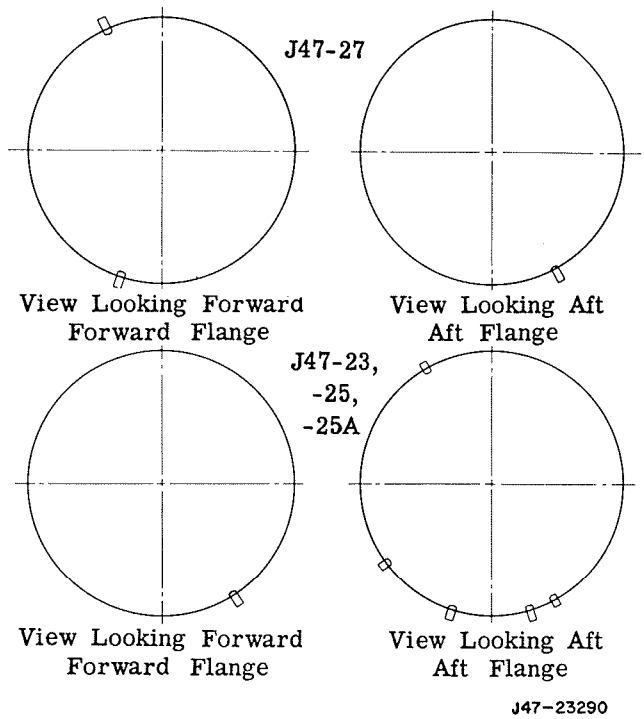


Figure 6–31. Location of Brackets on Forward and Rear Flanges of Compressor Stator Casings

Pages 259 through 262 deleted, figures 6–32 through 6–45 deleted.

6–18. DELETED.

6–19. DELETED.

6–20. DELETED.

6–21. DELETED.

6–22. DELETED.

6–23. TRANSFERRING THE ENGINE TO THE HORIZONTAL POSITION.

6–24. LOWERING THE ENGINE TO THE HORIZONTAL POSITION.

Note

For special tools, see Section II, group 34.

a. Attach lifting sling 1C2043 (1, figure 6–46) to brackets 1C2037 (3).

Note

The ears of bracket 1C2037 should face the rear of the engine.

b. Disconnect stabilizer bar 1C2035–2 from the compressor rear frame and from the assembly stand 1C2030 (2, figure 6–46).

c. Disconnect the stabilizing bar between the compressor front frame and the assembly stand at the compressor front frame.

d. Move the engine into the horizontal position by slowly lowering sling 1C2043.

Note

It may be necessary to start the engine moving by pushing by hand at the start.

e. For the remaining work on the engine, the engine may be left in stand 1C2030, or transferred to the M–2 transportation stand. If further work is to be done with the engine in stand 1C2030, install auxiliary support 1C2187. (See figure 6–47.)

6–25. OUTSIDE PIPING, WIRING, AND COMPONENTS.

6–26. ASSEMBLY OF OUTSIDE PIPING AND WIRING.

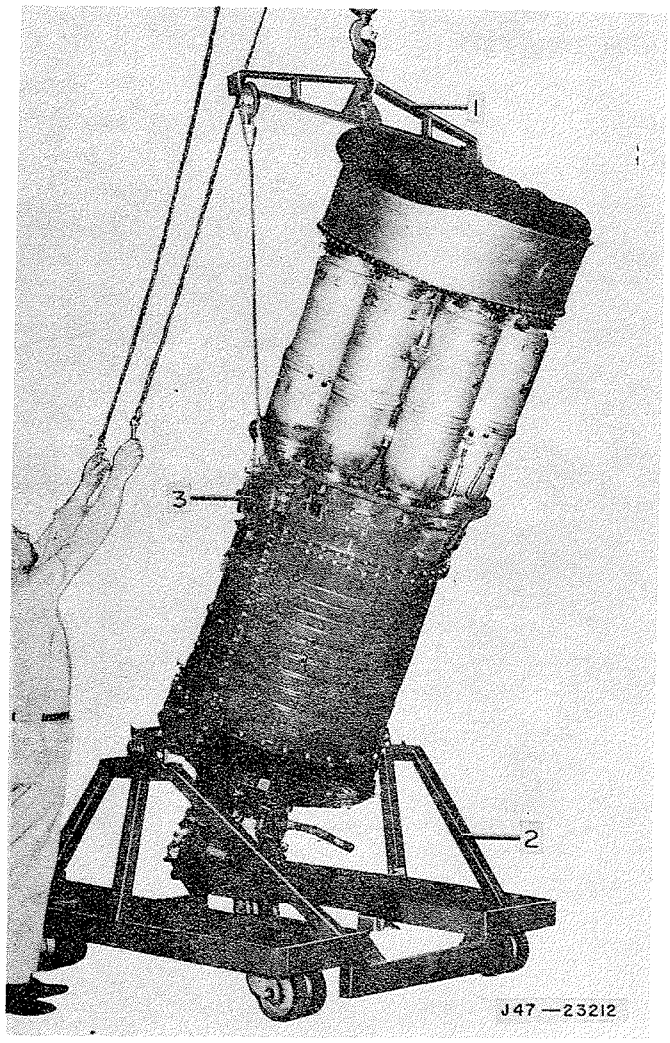
6–27. INSTALLING OUTSIDE PIPING AND WIRING TO THE J47–27 ENGINES.

Note

All index numbers in parentheses refer to figure 6–48. All reference numbers refer to values in Section VIII, Tables of Limits. For special tools see group 25, Section II.

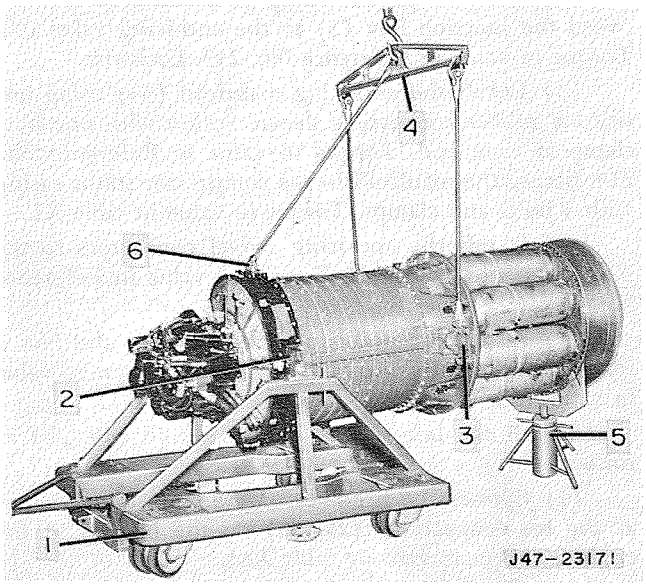
Note

Install chafing guards P/N 9451812 or authorized alternate as required on hoses and electrical leads, reference T.O. 2J-J47-24.



1. Sling 1C2043 2. Stand 1C2030 3. Bracket 1C2037

Figure 6–46. Lowering the Engine to the Horizontal Position



1. Stand 1C2030
2. Bracket 1C619-59
3. Bracket 1C2037
4. Sling 1C2043
5. Support 1C2187
6. Bracket 1C2153

Figure 6-47. Engine in Horizontal Position with Aft End Supported by Auxiliary Support 1C2187

a. Install the flex line (25) of the combustion chamber drain manifold between the forward drain block and the turbine casing drain. Torque to value in table XLI.

b. Install the drain tube between the forward drain block and the turbine casing drain. Torque to value in table XLI.

c. Install 2 ignitor plugs (21, 22) and gaskets into combustion chamber No. 7. Secure each ignitor plug with 2 screws. Torque to value in Reference No. 172. Lockwire.

d. Install large and small slot fuel manifold (19, 20) as follows:

(1) Connect large slot fuel hoses between the large slot manifold (20) and the fuel nozzles.

(2) Connect small slot fuel hoses between small slot manifold (19) and fuel nozzles.

(3) Secure the 4 mounting brackets to the fuel nozzles with 2 bolts and washers each. Torque to Reference No. 162 and lockwire.

(4) Torque the large slot fuel hoses to value in Reference No. 210.

(5) Torque the small slot fuel hoses to value in Reference No. 211.

e. Install 2 ignitor leads between the ignitor coils (15) and (16) and the spark plugs as follows:

(1) Secure one end of each ignitor lead to the ignition coils (15) and (16).

(2) Insert the loose ends of the ignitor leads through the ports in the compressor rear frame flange.

(3) Install a gasket to each ignitor lead port in the compressor rear frame flange and secure with 4 retainers, 2 bolts and nuts. Torque to value in table XLII.

(4) Secure the loose ends of the ignitor leads to the ignitor plugs (21, 22). Torque both ends of the leads to value in Reference No. 212.

Note

Do not use anti-seize of any type on the ignitor leads.

(5) Secure the lower ignitor lead to the small slot manifold with 2 chafing guards. Secure the upper ignitor lead to the small slot manifold with one chafing guard.

f. Install the aft turbine cooling air tube (27) with wrench 1C723 (figure 2-6) between No. 1 and 2 combustion chambers. Torque to value in table XLI.

g. Install the thermocouple lead (30, figure 6-48) from the junction box (2), through the firewall and clamp it to the turbine rotor cooling air tube (27). Torque the electrical connector to value in Reference No. 213.

Note

The thermocouple lead is routed under the ignition coil leads.

h. Install the anti-icing tube between the twelfth stage air extraction pad (18) and the compressor front frame anti-icing connector (13) as follows:

(1) Install one silicone rubber connecting sleeve to each end of the anti-icing tube.

(2) Install the anti-icing tube between the twelfth stage air extraction pad (18) and the compressor front frame anti-icing connector (13) with 2 hose clamps at each end. Torque to value in Reference No. 214.

i. Install the fuel flow divider leakage hose between the check valve on the flow divider (17) and the 45-degree elbow on the fuel inlet fitting on No. 3 island cover. Torque to value in table XLI. Secure the hose with 2 hose clamps to the anti-icing tube. Torque securing bolts to value in table XL.

j. Install the compressor front frame strut anti-icing tubes between the compressor front frame anti-icing connectors (13) and the compressor front frame strut ports. Torque to value in table XLI.

k. Install the fuel outlet hose between No. 2 island and the oil cooler (12). Torque to value in table XLI. To prevent twisting and kinking of the hose, position and torque the No. 2 island end of the hose first.

Note

Clamp the fuel outlet hose and the fuel flow divider leakage hose together at the compressor front frame bracket. Torque to value in table XLII.

l. Install the compressor rear frame fire warning lead (26) at the junction box (2). Torque to value in Reference No. 213. Clamp the lead to the compressor casing at the vertical split line flange.

Note

The fire warning lead will be coiled and secured to the fuel manifold with tape or cord. This lead is connected to the air frame buildup kit.

m. Install the island fairings to the compressor front frame and secure each fairing with 2 camloc fasteners.

n. Install No. 1 and 2 island anti-icing swivel connectors. Torque to value in Reference No. 215.

o. Install the compressor discharge pressure sensing tube, union and hose between the take-off elbow on the upper compressor casing and the air solenoid valve (5). Torque to value in table XLI.

p. Connect the anti-icing tubes to the swivel fittings on No. 1 and 2 islands. Torque to value in table XLI.

q. Install the electrical leads between the engine junction box (2) and the No. 1 island junction box (1). Torque to value in Reference No. 213.

Note

The electrical leads connected between the bottom of the engine, the main junction box (2) and No. 1 island junction box (1) should be routed under the air inlet screen jack shaft linkage and secured with blue skin lacing.

r. Install the electrical lead between the engine junction box (2) and the screen actuator motor (32). Torque to value in Reference No. 213.

s. Install the fuel drain tee assembly as follows:

(1) Install 3 unions and gaskets to the fuel drain tee.

(2) Install the drain line between the No. 3 island and the fuel drain tee.

(3) Install the drain line from the check valve on the emergency fuel regulator (7) to the upright union on the drain tee.

(4) Cap off the open port on the drain tee. Torque all connections to values in table XLI.

t. Install the emergency fuel regulator outlet hose between the emergency fuel regulator (7) and No. 3 island. Position the elbow and torque to value in table XLVIII. Torque the hose to value in table XLI.

u. Install the scavenge oil hose between the thermal by-pass valve (11) and the No. 3 island. Torque to value in table XLI.

v. Install the oil supply line between the No. 3 island and the oil filter (10). Torque to value in table XLI.

w. Install the emergency fuel inlet line between the emergency fuel regulator (7) and the No. 3 island. Position the elbow and torque to value in table XLVIII. Torque the hose to value in table XLI.

x. Install the anti-icing valve and manifold as follows:

(1) Install the anti-icing valve (9) to the compressor stator casing and secure with 2 bolts and washers. Torque to value in Reference No. 143. Lockwire.

(2) Connect the anti-icing valve electrical lead between the junction box (2) to the anti-icing valve (9). Torque to value in Reference No. 213. Lockwire.

(3) Install the anti-icing manifold (33) using one silicone rubber connecting sleeve. Secure with one hose clamp at each end. Torque to value in Reference No. 214. Secure the manifold to the compressor stator casing with 3 bolts and clamps. Torque to value in table XL.

(4) Install the anti-icing swivel connectors to the No. 3 and No. 4 islands. Torque to value in Reference No. 215.

(5) Install the anti-icing tube between the No. 3 island and the anti-icing manifold (33). Torque to value in table XLI.

y. Install the left side of fuel manifold (19, 20) as follows:

(1) Connect both halves of the manifold together at the tee connections (28, 29) on the bottom of the engine. Torque to value in table XLI.

(2) Connect the large slot fuel hoses between the large slot manifold (20) and the fuel nozzles.

(3) Connect the small slot fuel hoses between the small slot manifold (19) and the fuel nozzles.

(4) Connect 4 brackets to the fuel nozzles and secure with 2 bolts and washers each. Torque to value in Reference No. 162. Lockwire.

(5) Torque the large slot fuel hoses to value in Reference No. 210.

(6) Torque the small slot fuel hoses to value in Reference No. 211.

z. Install the anti-icing tube between the compressor rear frame port and the anti-icing valve (9). Use 4 bolts and washers and one gasket at the rear mounting flange and one silicone rubber connecting sleeve and 2 hose clamps at the front end of the tube. Torque bolts at rear mounting flange to value in Reference No. 165. Lockwire. Torque the hose clamps to value in Reference No. 214.

aa. Install the compressor front frame strut anti-icing tubes between the anti-icing connector (8) and the fittings on the compressor front frame. Torque to value in table XLI.

ab. Install the anti-icing tube between the twelfth stage air extraction pad (31) and the anti-icing connector (8) using a silicone rubber connector sleeve and 2 hose clamps at each end of the tube. Torque the clamps to value in Reference No. 214.

ac. Connect the anti-icing tube between the anti-icing manifold (33) and the swivel fitting on the No. 4 island. Torque to value in table XLI.

ad. Install the emergency fuel pressure sensing line between the emergency fuel regulator (7) and the No. 4 island. Torque to value in table XLI.

ae. Install the compressor discharge pressure sensing hose between the air solenoid valve (5) and the No. 4 island. Torque to value in table XLI.

af. Install a 45-degree elbow with jam nut and seal to the connector on the compressor rear frame. Torque to value in table XLVIII.

ag. Assemble and install the check valve and 2 oil return hoses between the oil thermal by-pass valve (11) and the elbow on the compressor rear frame. Torque to value in table XLI.

Note

Install the check valve with the arrow pointing in the direction of oil flow.

ah. Secure the check valve to the compressor stator casing bracket with one clamp, bolt, nut and washer. Torque to value in table XLII.

ai. Install rear bearing oil supply hose between the lube pressure sensing tee (33) and the elbow on the compressor rear frame. Torque to value in table XLI.

aj. Install 2 ignitor plugs (23, 24) and gaskets to combustion chamber No. 3. Secure with 2 screws each. Torque to value in Reference No. 172. Lockwire.

ak. Install 2 ignitor leads between the ignitor coils (3, 4) and the ignitor plugs as follows:

(1) Secure one end of each ignitor lead to the ignitor coils (3, 4).

(2) Thread the loose ends of the ignitor leads through the ports in the compressor rear frame flange.

(3) Install a gasket to each ignitor plug lead port in the compressor rear frame flange and secure with 4 retainers, 2 bolts and nuts. Torque to value in table XLII.

(4) Secure the loose ends of each ignitor leads to the ignitor plugs, (23, 24). Torque both ends of the leads to value in Reference No. 212.

Note

Do not use anti-seize of any type on the ignitor leads.

(5) Secure the lower ignitor lead to the small slot manifold with 2 chafing guards.

(6) Secure the upper ignitor lead to the small slot manifold with one chafing guard.

al. Install the eighth stage cooling air tube between the eighth stage air extraction pad (14) and the compressor rear frame as follows:

Note

It will be necessary to align the cooling air bellows with the drilled holes in the compressor rear frame before securing the cooling air tube.

(1) Secure the aft end of eighth stage cooling air tube using one gasket on each side of compressor rear frame and 3 bolts and washers. Torque to value in table XL. Lockwire.

(2) Install the hoses between the large and small slot ports on the fuel flow divider (17) and the large and small slot fuel manifold tees (28, 29). Torque to value in table XLI.

6–28. INSTALLING OUTSIDE PIPING AND WIRING TO J47–23, –25, and –25A ENGINES.

Note

All index numbers in parentheses refer to figure 6–49. All reference numbers and Tables refer to values in Section VIII, Table of Limits. For special tools see Section II, group 25.

Note

Install chafing guard P/N 9451812 or authorized alternate as required on hoses and electrical leads, reference T.O. 2J-J47-24.

a. Install the flexline (25) of the combustion chamber drain manifold between the forward drain block and the turbine casing. Torque to value in table XLI.

b. Install the drain tube between the turbine casing drain and the forward drain block. Torque to value in table XLI.

c. Install 2 ignitor plugs (21, 22) and 2 gaskets into No. 7 combustion chamber. Secure each ignitor plug with 2 screws. Torque to value in Reference No. 172 and lockwire.

d. Install large and small slot manifold assembly (19, 20) as follows:

(1) Connect large slot fuel hose assemblies between large slot manifold (20) and fuel nozzles.

(2) Connect small slot fuel hose assemblies between small slot manifold (19) and fuel nozzles.

(3) Secure 4 mounting brackets to the fuel nozzles with 2 bolts and washers, each. Torque to value in Reference No. 162. Lockwire.

(4) Torque the large slot fuel hoses to value in Reference No. 210.

(5) Torque the small slot fuel hoses to value in Reference No. 211.

e. Install 2 ignitor leads between the ignitor coils (15, 26) and ignitor plugs (21, 22) as follows:

(1) Secure one end of each ignitor lead to ignitor coils (15, 16).

(2) Insert loose ends of the ignitor leads through the ports in compressor rear frame flange.

(3) Install a gasket to each ignitor lead port in the compressor rear frame flange and secure with 4 retainers, 2 bolts and nuts. Torque to value in table XLII.

(4) Secure the loose ends of the ignitor leads to the ignitor plugs (21, 22) in No. 7 combustion chamber. Torque to value in Reference No. 212.

Note

Do not use anti-seize of any type on the ignitor leads.

(5) Secure lower ignitor lead to small slot manifold with 2 chafing guards.

(6) Secure upper ignitor lead to small slot manifold with one chafing guard.

f. Install the aft turbine cooling air tube (27) with wrench 1C723 (figure 2–6) between No. 1 and 2 combustion chambers. Torque to value in table XLI.

g. Install the thermocouple lead (30) from junction box (2) through the firewall and clamp it to the turbine rotor cooling air tube. Tighten the electrical flexible conduit knurled nut finger-tight and lockwire it. Torque the coupling nuts to 40–50 pound-inches.

Note

The thermocouple lead (30) is routed under ignition coil lead.

h. Install the anti-icing tube between the twelfth stage air extraction pad (31) and the compressor front frame anti-icing connector (8) as follows:

(1) Install one silicone rubber connecting sleeve to each end of anti-icing tube.

(2) Install the anti-icing tube between the twelfth stage air extraction pad (31) and the compressor front frame anti-icing connector (8) with 2 hose clamps at each end. Torque hose clamps to value in Reference No. 214.

i. Install the fuel flow divider leakage hose between the check valve (17) on flow divider and the return port on the fuel inlet fitting on No. 3 island. Torque to value in table XLI. Secure the hose to the anti-icing tube with 2 hose clamps. Torque the securing bolts to table XLII.

j. Install the compressor front frame strut anti-icing tubes between the compressor front frame anti-icing connector (8) and the compressor front frame strut ports. Torque to value in table XLI.

k. Install the fuel outlet hose between the No. 2 island and the oil cooler (12). Torque to value in table XLI. To prevent twisting and kinking, position and torque the No. 2 island end of hose first.

Note

Clamp the fuel outlet hose and the fuel flow divider leakage hose together at the compressor front frame bracket. Torque to value in table XLII.

l. Install the island fairings to the compressor front frame and secure each fairing with 2 camloc fasteners.

m. Install No. 1, 2, 3 and 4 island anti-icing swivel connectors. Torque to value in Reference No. 215.

n. Install the anti-icing valve (9) and the anti-icing manifold (33) as follows:

(1) Install the anti-icing valve (9) to the compressor stator casing and secure with 3 bolts and washers. Torque to value in Reference No. 143. Lockwire.

(2) Assemble the anti-icing tube and gasket to the anti-icing valve assembly with 4 bolts and washers. Torque to value in table XL. Lockwire.

(3) Secure the anti-icing manifold assembly (33) to the compressor stator casing with 4 clamps, bolts, and washers. Torque to value in table XL. Lockwire.

(4) Connect the anti-icing tube to the anti-icing manifold (33) with one silicone rubber connecting sleeve and 2 hose clamps. Torque the hose clamps to value in Reference No. 214.

(5) Connect the anti-icing tube between the anti-icing manifold (33) and the No. 3 island. Torque to value in table XLI.

(6) Connect the anti-icing tubes between the anti-icing manifold (33) and the swivel fittings on the No. 1, 2, 3, and 4 island covers. Torque to value in table XLI.

(7) Connect the anti-icing valve lead between the junction box (2) and the anti-icing valve (9). Torque to value in Reference No. 213. Lockwire.

o. Connect the fuel hose between the No. 3 island and the accumulator guide cowl (26). Torque to value in table XLI.

p. Connect the scavenge oil hose between the thermal by-pass valve (11) and No. 3 island. Torque to value in table XLI.

q. Connect the oil supply hose between the No. 3 island and the oil filter (10). Torque to value in table XLI.

r. Install the large and small slot manifold assembly (19, 20) as follows:

(1) Connect both halves of the fuel manifold (19, 20) together at the tee connections (28, 29) on the bottom of the engine. Torque to value in table XLI.

(2) Connect the large and small slot hoses to the fuel nozzles.

(3) Secure the left side of the manifolds (19, 20) to the fuel nozzles with 4 brackets. Bolt the brackets to the fuel nozzles with 2 bolts and washers each. Torque to value in Reference No. 162. Lockwire.

s. Connect the fuel hose between the large slot manifold tee (28) and the fuel flow divider (17). Torque to value in table XLI.

t. Connect the fuel hose between the small slot manifold tee (29) and the fuel flow divider (17). Torque to value in table XLI.

u. Install the anti-icing tube between the compressor rear frame port and the anti-icing valve (9) as follows:

(1) Install the anti-icing tube and gasket to the compressor rear frame. Secure with 4 bolts and washers. Torque to value in Reference No. XL. Lockwire.

(2) Connect the anti-icing tube to the anti-icing valve (9) with one silicone rubber connecting sleeve and 2 hose clamps. Torque the hose clamps to value in Reference No. 214.

v. Connect the compressor front frame strut anti-icing tubes between the anti-icing connector (13) and the fitting on the compressor front frame strut port. Torque to value in table XLI.

w. Connect the anti-icing tube between the twelfth stage air extraction pad (18) and the anti-icing connector (13) with one silicone rubber connecting sleeve and 2 hose clamps. Torque the hose clamps to value in Reference No. 214.

x. Connect the compressor discharge pressure sensing hose between the air metering orifice (5) and the connection on the No. 4 island. Torque to value in table XLI. Secure the hose to the bracket on the compressor front frame vertical flange, with one clamp, bolt, nut and washer. Torque to value in table XLII. Secure the hose to the compressor stator casing with one

clamp, bolt and washer. Torque to value in table XL. Lockwire.

y. Install a 45-degree elbow, O-ring, and jam nut to the oil connector on the compressor rear frame. Torque to table XLVIII.

z. Assemble oil return check valve and 2 hoses as follows:

CAUTION

Make certain the arrow on the check valve points in the direction of oil flow.

(1) Connect the oil return hose between the oil thermal by-pass valve (11) and the elbow on the compressor rear frame. Torque all connections to value in table XLI.

(2) Secure the check valve to the compressor stator casing bracket with a clamp, bolt, nut and washer. Torque to value in table XLII.

aa. Connect the oil supply hose between the oil pressure sensing tee (34) and the elbow on the compressor rear frame. Position and torque the compressor rear frame end first. Torque both ends to value in table XLI.

ab. Install 2 ignitor plugs (23, 24) and 2 gaskets into No. 3 combustion chamber. Secure each ignitor plug with 2 screws. Torque to value in Reference No. 172.

ac. Install the ignitor leads as follows:

(1) Connect one ignitor lead to each ignition coil (3, 4). Torque to value in Reference No. 212.

Note

Do not use anti-seize of any type on the ignitor leads.

(2) Insert the loose end of each ignitor lead through the port in the compressor rear frame flange.

(3) Install one gasket to each ignitor lead port on the compressor rear frame flange. Secure each gasket with 4 retainers, two bolts and nuts. Torque to value in table XLII.

(4) Secure the loose ends of the ignitor leads to the ignitor plugs (23, 24) in the No. 3 combustion chamber. Torque to value in Reference No. 212.

Note

Do not use anti-seize of any type on the ignitor leads.

(5) Secure the lower ignitor lead to the small slot manifold with 2 chafing guards.

(6) Secure the upper ignitor lead to the small slot manifold with one chafing guard.

ad. Install the eighth stage cooling air tube between the air extraction pad (14) and the compressor rear frame as follows:

(1) Align the eighth stage cooling air bellows and gasket between No. 7 and 8 combustion chambers to the drilled holes on the compressor rear frame.

(2) Install one gasket to the outside and one gasket to the inside of the compressor rear frame port. Secure the aft end of eighth stage cooling air tube with 3 bolts and washers. Torque to value in table XL. Lockwire.

ae. Connect the loose end of tachometer lead from the No. 1 island to the engine junction box (2). Torque to value in Reference No. 213. Lockwire.

af. Connect the screen actuator motor lead between the screen actuator motor (32) and the engine junction box (2). Torque to value in Reference No. 213. Lockwire.

ag. Install the water-alcohol manifold to the combustion section as follows:

(1) Install 4 water-alcohol manifold brackets to the compressor rear frame flange. Secure each bracket with one bolt, washer, and nut. Torque to value in table XLII.

(2) Position the water-alcohol manifold check valve (35) between No. 1 and 8 combustion chambers.

(3) Connect both the right and left halves of the water-alcohol manifold (26) to the check valve tee. Torque to value in table XLI.

(4) Secure the right and left halves of the water-alcohol manifold (26) together (between combustion chambers No. 4 and 5) with one bolt, washer and nut. Torque to value in table XLII.

(5) Secure the water-alcohol manifold assembly (26) to each compressor rear frame bracket with one clamp, screw and washer. Torque to value in table XL.

ah. Connect the water alcohol tube between the water-alcohol manifold assembly (26) and each combustion chamber water-alcohol inlet fitting. Torque to value in table XLI.

6-29. CONTROL LINKAGE.

6-30. INSTALLING AND ADJUSTING EMERGENCY FUEL REGULATOR LINKAGE.

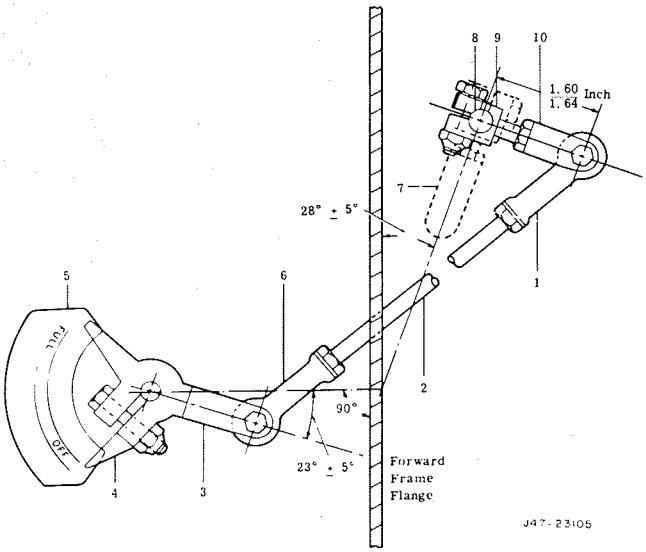
Note

Throughout this paragraph numbers in parentheses refer to figure 6-50 unless otherwise stated.

a. Assemble emergency control adjustment clevis (10) to emergency control clamp (9). Thread adjustment clevis into control clamp until distance from center of splined hole on control clamp to center of bolt hole on adjustment clevis is 1.60 to 1.64 inches. Torque locknut. Refer to Section VIII, Reference No. 127 for torque value.

b. Install emergency control adjustment clevis assembly to emergency control shaft as follows:

(1) Rotate the emergency regulator shaft clockwise until it engages an internal stop. (Full-open position.)



1. Rod End Bearing
2. Push Rid
3. Control Lever Rotated to Full Closed Position
4. Pointer
5. Escutcheon Plate
6. Rod End Bearing
7. Position of Adjustable Clevis when Emergency Regulator is in Full Open Position
8. Emergency Control Shaft
9. Emergency Control Clamp
10. Emergency Control Adjustable Clevis

Figure 6-50. Emergency Fuel Regulator Control Linkage

(2) Install the emergency control adjustment clevis assembly (10) to control shaft (8) so that an angle of 28 plus or minus 5 degrees is formed between center line of the emergency control adjustment clevis and the compressor front frame flange. Secure clevis with bolt, washer, and nut. Torque nut. Refer to Section VIII, Reference No. 124 for torque value. Line up the cotter key holes and install cotter key.

(3) Rotate main control shaft counterclockwise until an internal "off" stop is engaged. Assemble the control lever (3) to the main control shaft so that an angle of 23 plus or minus 5 degrees is formed between the center line of the main control lever and a line perpendicular to the compressor front frame flange through the main control shaft center line.

(4) Secure the main control lever with bolt, washer, and nut. Torque nut. Refer to Section VIII, Reference No. 124 for torque value. Line up the cotter key holes and install cotter key.

c. Install the push rod assembly (2) between the emergency control adjustment clevis (10) and the main control lever (3) as follows:

(1) Hold both the emergency regulator and main control in full off position (CCW) and install the pushrod assembly. Secure with bolt and washer at each end. Torque. Refer to Section VIII, Reference No. 126. Torque both push rod to rod bearing locknuts. Refer to Section VIII, Reference No. 127.

(2) Disconnect one end of push rod assembly and shorten push rod 2 complete turns at unsecured end. Torque locknut. Refer to Section VIII, Reference No. 127 for torque value.

(3) Secure the disconnected end of the push rod with a bolt and washer. Torque. Refer to Section VIII, Reference No. 127 for torque value. Install lockwire on each bolt.

d. Operate linkage through 2 complete cycles to check for binding and seizing.

e. From full "off" position rotate control lever 90 degrees. Set pointer in "full" position on escutcheon plate. Adjust high speed stop setscrew so control lever rotation is limited to 90 degrees. Return control lever to "off" position.

NOTE

Travel of control lever arm is limited to 90 degrees at this time to eliminate the possibility of overspeed on initial test cell run. High speed stop will be properly adjusted in test cell.

6-31. FINAL ASSEMBLY.

6-32. ASSEMBLY OF ACCESSORY DRIVE MOUNTS.

6-33. INSTALLING HYDRAULIC PUMP DRIVE GEARCASE ON J47-27 ENGINES.

NOTE

For special tools, see Section II, group 24.

a. Install the inner coupling assembly into accessory drive shaft in front frame, using pusher-puller 1C785. (See figure 3-8.)

b. Install the accessory drive shaft housing and O-ring. Secure with snap ring, using pliers 1C899 (figure 1-9).

NOTE

Some of the earlier model shaft housings have an indexing pin and should be installed with pin in 12 o'clock position.

c. Install the drive shaft into the front frame through the shaft housing.

CAUTION

Before installing the auxiliary drive shaft, be certain that snap rings are installed in the grooves machined in the internal splines of the mating shafts. Both in the hydraulic pump drive gear case and in the compressor front frame. These snap rings are necessary to prevent disengagement of the drive shaft during engine operation.

d. Hold the hydraulic pump gearcase assembly up to the front frame and pull the fuel filter, regulator filter, and hoses through openings.

e. Reaching through hydraulic pump drive gearcase assembly, connect the scavenge pump lube outlet line to the scavenge pump. Refer to Section VIII, table XLI for torque value.

f. Assemble the hydraulic pump drive gearcase assembly and install Allen-head screws and snaprings. Torque. Refer to Section VIII, Reference No. 71 for torque value.

CAUTION

Make certain that snaprings are seated flush in recesses.

g. Secure the main fuel filter bracket to the hydraulic pump drive gearcase with 3 bolts and washers. Torque. Refer to Section VIII, Reference No. 76 for torque value. Lockwire bolts. Secure main fuel filter to bracket with 2 bolts and washers. Torque. Refer to Section VIII, Reference No. 77 for torque value. Lockwire.

h. Secure regulator filter bracket to hydraulic pump drive gearcase with 2 bolts and washers. Torque. Refer to Section VIII, Reference No. 75 for torque value. Lockwire the bolts.

i. Secure fuel control valve to hydraulic pump drive gearcase with 2 bolts and washers. Torque. Refer to Section VIII, Reference No. 78 for torque value. Lockwire.

j. Secure the bullet nose anti-icing line onto hydraulic pump drive gearcase with bracket, nut and bolt. Torque. Refer to Section VIII, table XLII for torque value.

k. Connect the lube inlet line to hydraulic pump drive gearcase cover at the 3 o'clock position. Torque. Refer to Section VIII, table XLI for torque value.

6-34. INSTALLING ALTERNATOR MOUNT ASSEMBLY ON J47-23, -25 AND -25A ENGINES.

Note

The alternator mount assembly is not shipped with the engine, but installation instructions are given for use when the engine is to be installed into an aircraft. For special tools, see Section II, group 3.

a. Install the inner coupling into the compressor front frame, using pusher-puller 1C785. Secure with a snapring, using pliers 1C899 (figure 2-9).

b. Install the alternator drive shaft housing and O-ring into the compressor front frame cap. Secure with a snapring, using pliers 1C899.

c. Install the alternator drive shaft into the compressor front frame through the shaft housing.

d. Hold the alternator mount assembly up to the compressor front frame and pull the main fuel filter, the regulator filter and orifice and hoses through opening.

e. Reach through the alternator mount assembly and connect the oil supply line to the top of the bearing housing. Torque. Refer to Section VIII, table XLI for torque value.

f. Secure the alternator mount to the cowl support with 9 Allen-head screws. Torque. Refer to Section VIII, Reference No. 71, for the torque value. Install snaprings.

CAUTION

Make certain that snaprings are properly seated in recesses.

g. Connect the lube outlet scavenge line to the alternator mount at the 6 o'clock position. Torque. Refer to Section VIII, table XLI for torque value.

h. Secure the main fuel filter to the main fuel filter bracket with 2 bolts and washers. Torque. Refer to Section VIII, Reference No. 76, for torque value. Lockwire. Secure the main fuel filter bracket on the alternator mount with 2 bolts and washers. Torque. Refer to Section VIII, Reference No. 77 for torque value. Lockwire.

i. Secure the regulator filter and bracket to the alternator mount with 2 bolts and washers. Torque. Refer to Section VIII, Reference No. 75 for torque value. Lockwire.

j. Secure the fuel control valve to the alternator mount with 2 bolts and washers. Torque. Refer to Section VIII, Reference No. 78 for torque value. Lockwire.

k. Secure the bullet nose anti-icing line to the alternator mount with a bracket, nut and bolt. Torque. Refer to Section VIII, table XLI for torque value.

Note

On J47-23, -25 and -25A engines, where alternator mount is not installed, install cover and O-ring in front frame cap and secure with snapring.

6-35. INSTALLING ACCESSORY SUPPORT MOUNT.

Note

Cap-off or join together the lube supply and scavenge return hoses to the alternator mount if the alternator mount is not installed on the J47-23 engines.

a. Assemble the accessory support mount to the front frame. Secure with 6 Allen-head screws. Torque. Refer to Section VIII, Reference No. 71 for torque value. Install snaprings.

CAUTION

Make certain snaprings are properly seated in the recesses.

b. Secure main fuel filter bracket to accessory support mount with three bolts and washers. Torque. Refer to Section VIII, Reference No. 77 for torque value. Lockwire. Bolt the main fuel filter to the bracket with 2 bolts and washers. Torque. Refer to Section VIII, Reference No. 76 for torque value. Lockwire.

c. Secure the regulator filter and bracket to the accessory support mount with 2 bolts and washers. Torque. Refer to Section VIII, Reference No. 75 for torque value. Lockwire.

d. Secure the fuel control valve in place with 2 bolts and washers. Torque. Refer to Section VIII, Reference No. 78 for torque value. Lockwire.

e. Secure the bullet nose anti-icing line to the accessory mount with bracket, nut, and bolt. Torque. Refer to Section VIII, table XLII for torque value.

6-36. INLET SCREEN CLEARANCES.

6-37. CHECKING INLET SCREEN CLEARANCES.

Note

On some models of the J47-23, -25, and -25A engines, the air inlet screens have been removed.

a. With the air inlet screens in the fully extended position, check the clearance between the large island fairing and the air inlet screens. A minimum of 0.080 inches and a maximum of 0.250 inches is allowable. If the clearances do not fall within these limits, re-shim as described in Section V, paragraph 5–15.

b. With the air inlet screens in the fully extended position, check the clearance between the accessory cowl and the air inlet screens. On air inlet screens without rubber bumpers, the clearance must be 0.060 inches minimum and 0.250 inches maximum. On air inlet screens with rubber bumpers, the bumpers must make contact with the accessory cowl. If the clearances do not fall within these limits, adjust the screw jacks on the actuators as required.

6–38. PREPARATION FOR TESTING.

6–39. INSTALLING THE ENGINE IN THE TEST DOLLY.

Note

For special tools, see Section II, group 30.

a. Install lifting eye 1C981 to the mounting pad on top of the compressor rear frame.

b. Using suitable hoist, remove the engine from repair stand.

c. Install mounting adapter assembly and gasket to the mounting pads on the compressor rear frame. Secure each mounting adapter with 4 bolts and lockwire.

d. Install one trunnion bearing to each mounting adapter.

e. Install the engine into test dolly 1C1640 (figure 2–14), making certain that the mounting adapters are properly seated in the trunnion assemblies.

f. Lower the engine so the front support assembly can be attached to the lower mounting pad on the compressor front frame. Secure with 4 bolts and washers.

Note

Make certain a gasket is used between the mounting pad on the compressor front frame and the front support assembly.

g. Lock the engine to the test dolly by inserting a locking bar through each trunnion, locking the mounting adapter to the trunnion.

h. Install one washer and nut to each mounting adapter, and safety nut with a cotter pin.

6–40. INSTALLING THE EXHAUST CONE.

Note

The following assemblies are not shipped with the engine but are necessary for engine installation and operation. For special tools, see Section II, group 23.

a. On engines with standard shroud rings, install the exhaust cone to the turbine casing as follows:

(1) Install the shroud ring so that it is flush with the turbine nozzle rabbet around its entire circumference.

(2) Check the clearance between the shroud ring and the tip of the turbine buckets. Refer to Section VIII, Reference No. 39 for clearance.

(3) Install the exhaust cone and secure it with 80 bolts and nuts, using socket 1C711. Torque. Refer to Section VIII, Reference No. 186A for torque value.

(4) Check the clearance between the shroud ring and the tip of the turbine buckets again. Refer to Section VIII, Reference No. 39 for clearance.

b. On engines with floating type shroud ring proceed as follows to install the shroud ring:

(1) Install the floating shroud around the turbine rotor.

(2) To hold the shroud ring in position, install 4 plastic shims, 90 degrees apart, between the shroud ring and the turbine.

(3) Install 8 shims between the rear flange of the turbine casing and the exhaust cone. Secure with 80 bolts and nuts, using socket 1C711. Torque. Refer to Section VIII, Reference No. 186A for torque value.

Note

These shims must be flush with the outer circumference of exhaust cone flange.

Note

Table XXVIII lists the different combinations of floating and standard (fixed) shroud ring parts that can be used. You will note that "floating shroud rings" (124D466) are not used on standard nozzle diaphragms (8481860 for –23 and 507E246 for –25 and –27 engines).

c. Inspect the inner cone for sag at the 6 o'clock position (figure 6–50A). If the inner cone has dropped below the maximum sag limit on welded exhaust cone assembly, replace the exhaust cone. If the inner cone has dropped below the maximum sag limit on channel fairing exhaust cone assembly, proceed as follows:

Note

The bucket split line is the limit of maximum sag. This split line must be visible.

(1) Loosen the 32 screws securing the cooling air adapter and the rod and support sleeves to the outer cone (8, 9, 11, and 14, figure 5–84).

(2) With the screws loose, use a suitable pry and raise the inner cone from the 6 toward the 12 o'clock position until the sag is corrected.

CAUTION

Use care when raising the inner cone to prevent distortion or buckling of the inner and outer cone skin.

(3) With the inner cone held in the raised position, tighten the 32 screws. Refer to Section VIII, reference No. 216, for torque limit.

NOTE

The screws may have been weakened due to previous torque/operation and may stretch or break when retightened; therefore, it may be necessary to install new screws.

6-41. PREPARING THE ENGINE FOR STORAGE AND SHIPMENT.

6-42. PRESERVING THE ENGINE.

6-43. PRESERVING THE ENGINE IN THE TEST CELL.

NOTE

Refer to T.O. 2J-1-18 for preserving the engine in the test cell.

6-44. PRESERVING THE ENGINE OUTSIDE THE TEST CELL.

NOTE

See T.O. 2J-1-18 for engine preservation outside the test cell.

6-44A. PRESERVATION OF COMPRESSOR SECTION.

a. Compressor section corrosive treatment (spraying), using maximum one pint of undiluted Rustlick 606, FSN 8030-877-8096, or an approved alternate corrosion preventive oil prior to placing the engine in initial inactive storage and after each engine operational run-up for renewal of preservation.

6-44B. PRESERVATION OF FUEL SYSTEM.

a. Introduce oil conforming to specification MIL-O-6081, into the normal fuel inlet opening at 5-8 psig by means of an auxiliary pump.

b. Disconnect the small slot line at the flow divider.

c. Energize the main and emergency fuel systems, then rotate the engine to starting speed by means of the installed starter. Observe the starter operating limits. When clean oil is seen flowing from the disconnected small slot line, the operation is complete.

d. Upon completion of the preservation operation, wire the fuel shutoff valve in the closed position. Attach a tag to the fuel shutoff valve stating: THIS FUEL SYSTEM FLUSHED WITH OIL, SPECIFICATION MIL-O-6081.

e. Restore all lines and plugs; torque to required values and safety wire when required.

f. If conditions are such that motoring of the engine cannot be accomplished, the requirements of paragraph 6-44B will be complied with in its entirety, except introduce oil conforming to Specification MIL-O-6081, Grade 1010, into the normal fuel inlet openings at 20 - 40 psig in lieu of 5-8 psig and disregard motoring requirements.

6-45. REMOVING THE ENGINE FROM THE TEST DOLLY.

NOTE

For special tools, see Section II, group 31.

a. Place drain pans under engine.

b. Disconnect the lube oil pressure-sensing line from the pressure-sensing tee.

c. Disconnect the lube line from the fitting on the lube oil thermo check valve.

d. Disconnect the main fuel line from No. 3 island.

e. Disconnect the fuel line from the tee fitting on the oil cooler flow divider drain fitting.

f. Disconnect the lube line at No. 2 island.

g. Cap all lines and fittings.

h. Remove the drain pans from under the engine.

i. Remove the engine from engine test dolly 1C-1640 (figure 2-14) and install in M-2 transportation stand (figure 2-22) in following manner:

(1) Install lifting eye 1C981 (figure 6-51) or 1C686 to compressor rear frame, and secure with 4 bolts. Attach overhead hoist to lifting eye.

(2) Remove lockwire and 4 studs from the universal mount at the 6 o'clock position on the forward frame.

(3) Remove the 2 side lockpins from engine test dolly 1C1640.

(4) Lift engine from test dolly 1C1640. With engine suspended, install transportation stand bracket, 1C619-59 to the mounting pads on each side of the compressor front frame; install engine mounting trunnions to each side mounting pad on compressor rear frame.

(5) Lower the engine into the M-2 transportation stand and secure the front frame brackets to the stand.

6-46. INSTALLATION OF ENGINE AND COMPONENTS INTO SHIPPING CONTAINERS.

6-47. PREPARING THE J47-23, -25, AND -25A ENGINES FOR INSTALLATION INTO SHIPPING CONTAINERS.

a. When preparing the engine for storage or shipment, without the alternator or accessory shipping bracket installed, secure the fuel filter and fuel pressure control valve and fuel regulator oil filter with 1/2 inch nylon webbing, or equivalent.

(1) Thread the double strands of nylon webbing or equivalent through the mount stud, P/N 9451054, above the fuel filter so that the knot is drawn into the chamfered holes.

(2) Wrap the double strands of nylon webbing or equivalent around both fuel filter fittings as close to the filter body as possible. Start at the left fitting cross under the outlet fitting.

(3) Cover the top and make a wrap as close to the filter as possible, around the nylon webbing or equivalent running from the mount stud. Tighten up the nylon webbing or equivalent so that the fuel filter will be held in normal position.

(4) Make one complete wrap around the inlet fitting on the stopcock; tighten both strands of the nylon webbing or equivalent until the weight of the fuel filter is equally supported from the mount bracket to the stopcock fitting.

(5) From the stopcock fitting, make a complete wrap around the intake fitting on the fuel pressure control valve, drawing the nylon webbing or equivalent tight from the stopcock to the fuel pressure control valve.

(6) Proceed over the forward side of the fuel pressure control valve body through the hole in the mount stud directly to the left of the fuel pressure control valve.

(7) Tighten firmly and tie securely.

b. Using a single strand of nylon webbing or equivalent approximately 1 foot in length support the fuel filter in a downward position by securing the fuel-control-valve line to the fuel-pump elbow of the pump-to-control valve line; tighten to prevent upward movement of the fuel filter. Do not overstress the line between the fuel filter and the control valve.

c. Support the fuel regulator oil filter with 2 pieces of nylon webbing or equivalent, each of which is one foot long. Firmly secure the outlet line to the stopcock inlet elbow. Secure the inlet line to the stopcock housing. Wrap the lines at the point of contact with enough grease-proof wrapping paper, Specification JAN-B-121 to prevent chafing of lines and fittings.

6-48. INSTALLING THE ENGINE INTO THE SHIPPING CONTAINER.

NOTE

The following information applies to engines that are to be stored for a long time. For special tools, see Section II, group 27.

a. Rotate engine to flight position and install lifting eye 1C981 to compressor rear frame top mounting pad.

b. Lift the engine from the rollover stand. Remove the rollover rings and rollover ring mounting pads.

c. Inspect the mounting pad bores and threaded bushing for damage.

d. Assemble the shipping pad and gasket to compressor rear frame mounting pad at 3 and 9 o'clock positions. Refer to Section VIII, Table XL for torque value.

e. Assemble shipping pad and gasket to compressor front frame mounting pad at 3 and 9 o'clock positions. Refer to Section VIII, Table XL for torque value.

f. Assemble the turbine wheel collor to hub on turbine wheel.

g. Assemble the turbine wheel brace strongback over the turbine wheel with leg marked "Top" pointing to 12 o'clock position. Secure with 6 bolts and nuts. Refer to Section VIII, Reference No. 186 for torque value.

h. Torque the hub bolt. Refer to section VIII, Reference No. 225 for torque value. Remove hub bolt to check for proper seating against turbine bolt. Install the hub bolt and torque value. Torque locking nut. Refer to Section VIII, Reference No. 225 for torque value.

i. Install the paper dust cover over the compressor inlet section. Tape covers enough to prevent it from coming off.

j. Lockwire emergency fuel regulator linkage in closed position to prevent linkage from rattling during shipment.

k. Raise the engine and slide container underneath. Lower engine slowly into position in container. Secure with 4 nuts and lockwashers.

TABLE XXVIII. INSTALLATION COMBINATIONS

Component Parts		1	2	3	4	5	6	7	8	9	10	11	12
Turbine Casing (J47–25A)	508E658G1 & G2, 7032R31G1 & G2	x	x	x	x	x	x						
Turbine Casing (Standard)	9482600							x	x	x	x	x	x
Turbine Nozzle (J47–25A)	508E362	x	x	x	x					x	x	x	x
*Turbine Nozzle (Standard)	507E246					x	x	x	x				
Shroud Ring (J47–25A)	124D466	x	x									x	x
Shroud Ring (Standard)	124D103			x	x	x	x	x	x	x	x		
Exhaust Cone (J47–25A)	7032R80 or 7038R45G1	x		x		x			x		x		x
Exhaust Cone (Standard)	7021E45 or 7024R53		x		x		x	x		x		x	
Shims (127C544 or 414B448)	127C544 or 414B448	x	x	x									x

*There are 2 standard nozzle diaphragms, P/N 8481860 and P/N 507E246. The 8481860 has a throat area of 114–118 inches and is used only on the J47–23 engines. It is not to be used on J47–25, –25A or –27 engines.
Columns 1 and 2 are preferred combinations and columns 3, 4, 5 and 6 are alternate combinations for –25A engines.
Columns 7 and 8 are preferred combinations and columns 9, 10, 11 and 12 are alternate combinations for J47–23, –25 and –27 engines.

Note

Alternate combinations may be used as a last resort only when parts for preferred combinations cannot be obtained.

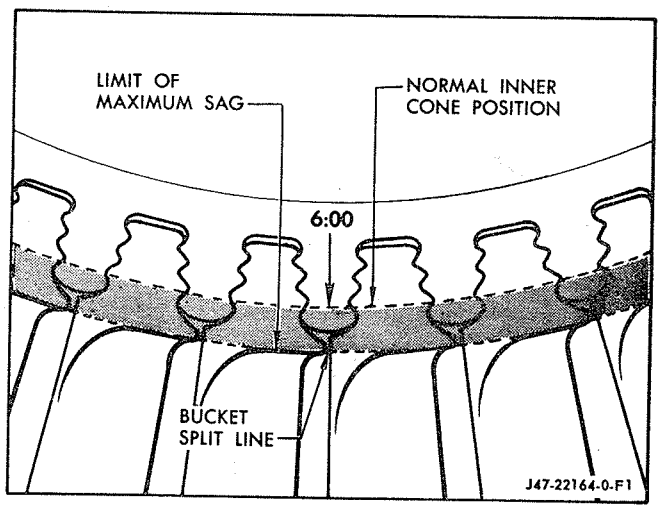


Figure 6–50A. Inner Cone Sag Limit

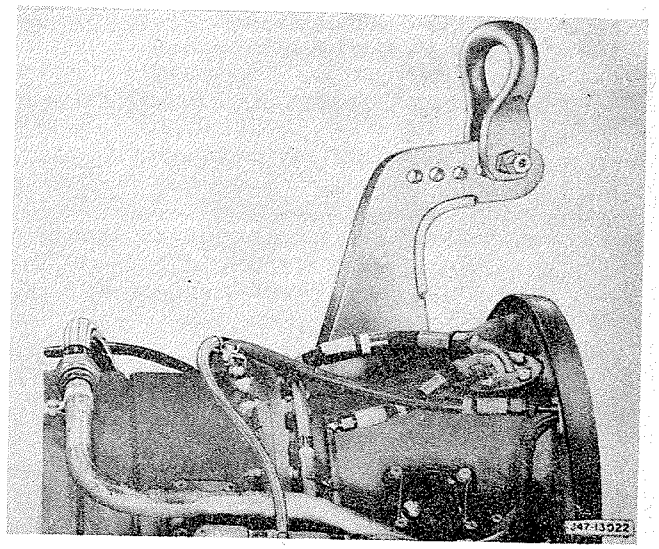
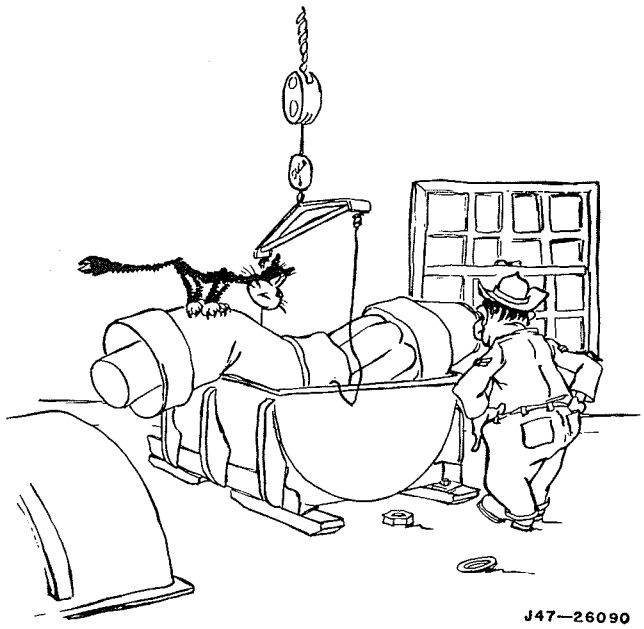


Figure 6–51. Lifting Eye 1C981 Installed



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CAUTION

To avoid engine damage, do not permit engine to strike sides of container or other objects in work area.

l. Remove lifting eye 1C981 (figure 6-52) and install one cover to top port on compressor rear frame.

m. Install the cover to the top port on the compressor front frame.

n. Install a humidity indicator to the inside of the glass opening, on front container.

o. Inspect to be sure the engine is securely and properly installed. Inspect to see that O-ring seal is properly positioned to flange of container.

p. Using proper sling, lift the container cover into place. Use drift pins to guide it into position.

q. Secure cover with 42 bolts (assembled from bottom upward) and 42 nuts. Torque. Refer to Section VIII, table XL for torque value. Paint nuts and bolts with OD paint, Specification MIL-E-5556.

r. Place one of the following groups of MIL-C-3464 desiccant into the wire cage through receptacle opening:

(1) 12 16-unit bags.

(2) 24 8-unit bags.

(3) 48 4-unit bags.

s. Install the air valve and the relief valve to the receptacle.

t. Position the valve receptacle in the opening and secure with clamping bar and bolt.

u. Install air hose adapter in the container through plug opening. Inflate to 5 psig with dehydrated air. (See figure 6-53.)

v. Remove the air hose and assemble plug to container.

w. Stencil all required information on container.

x. Install engine records in container provided for them.

Note

Refer to Specification MIL-E-5607 for added information on Storage and Shipment.

6-49. DELETED.

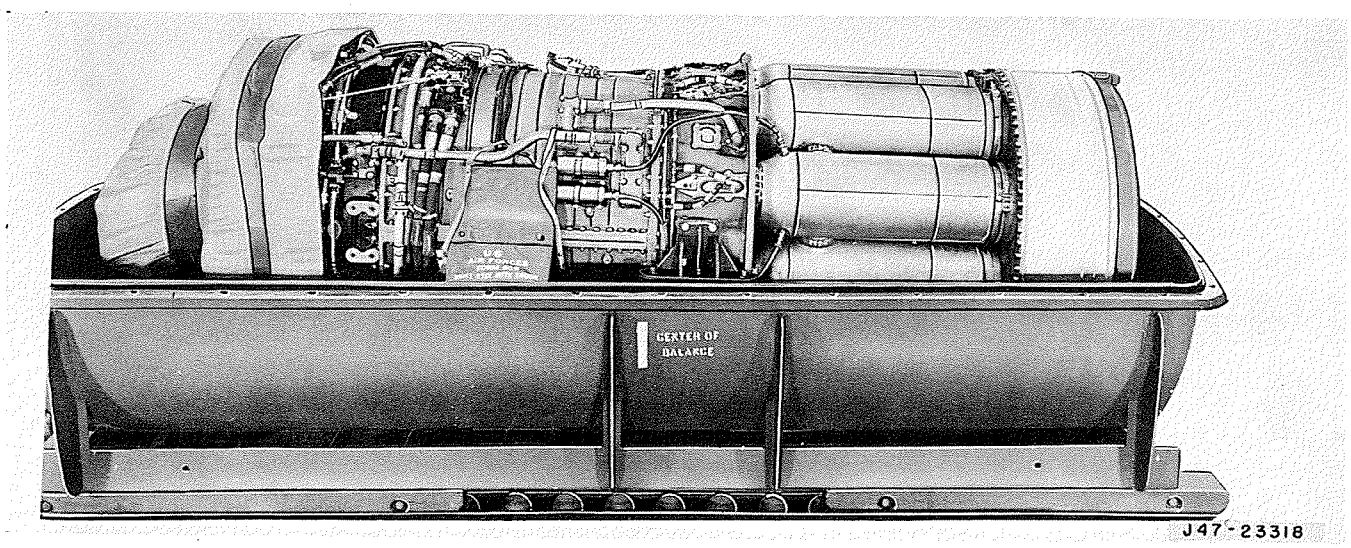

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Figure 6-52. Engine in Shipping Container

6–50. INSTALLING THE TURBINE ROTOR INTO SHIPPING CONTAINER.

Note

For special tools, see Section II, group 48.

a. With the turbine rotor installed in stand 1C982, spray the entire rotor with corrosion-preventive compound.

b. Install lifting adapter 1C983 to the turbine shaft forward of the No. 4 bearing journal.

c. Attach an overhead hoist to adapter 1C983 and lift the turbine rotor out of stand 1C982.

d. Install lifting adapter 1C987 to the splined end of the turbine rotor and attach second overhead hoist. (See figure 6–54.)

e. Transfer the turbine rotor from the horizontal to the vertical position by raising hoist attached to adapter 1C987 and lowering the hoist attached to adapter 1C983.

f. With turbine rotor in the vertical position, remove adapter 1C983 and hoist.

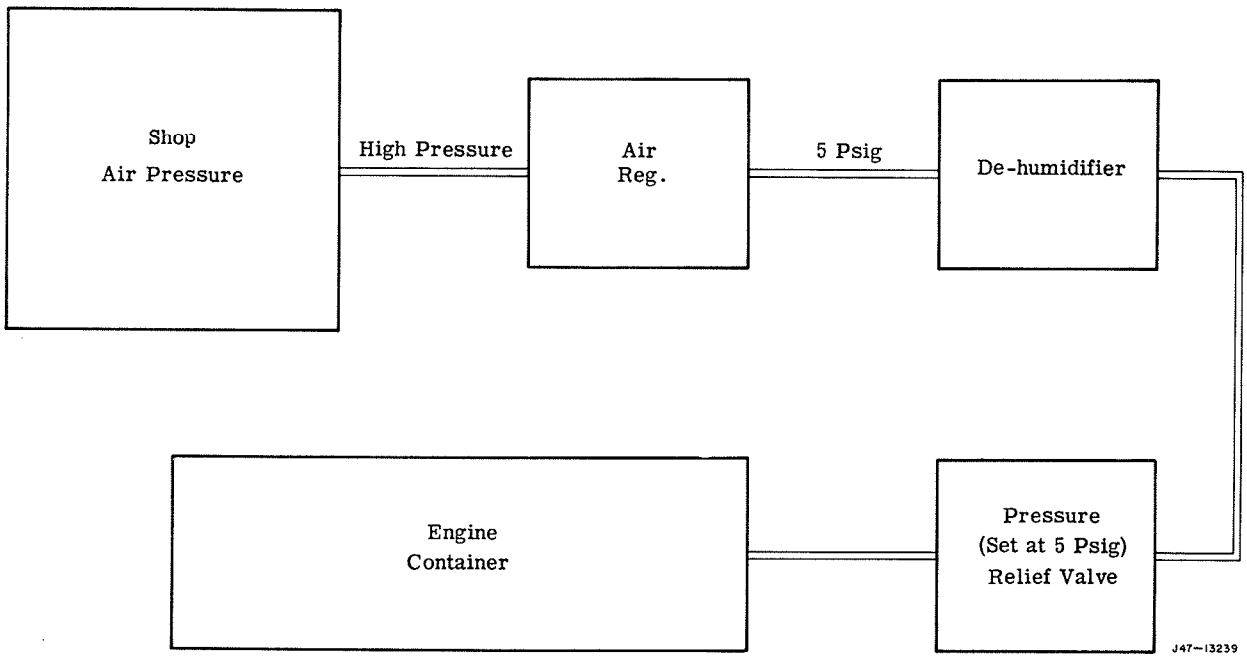


Figure 6–53. Steps for Filling Shipping Container with Dehydrated Air

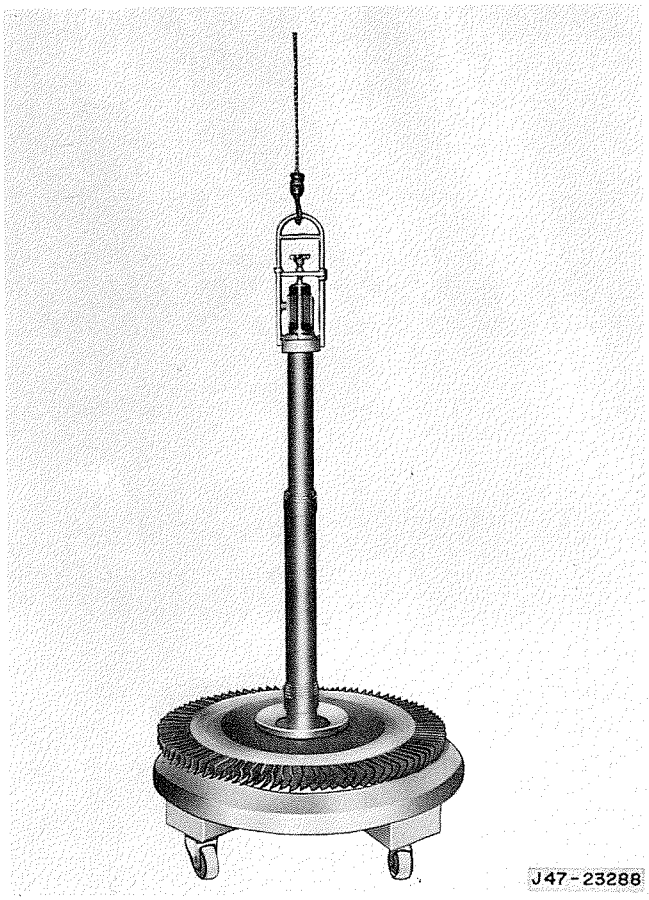


Figure 6-54. Turbine Rotor Lifting Adapter 1C987 Installed

g. Install paper to the turbine rotor shipping container so the rotor wheel and buckets will be completely covered when rotor is lowered into the container.

h. Lower turbine rotor into shipping container, making certain rotor rests squarely on rubber bumpers of container.

i. Wrap rotor shaft with paper and attach necessary forms.

Note

AF form AFTO-44 and form 50-D should be attached to defective rotor.

j. Remove lifting adapter 1C987 and hoist and install rubber ring bumpers to the rotor guide on the splined end.

k. Install silica-gel and humidity indicator to shipping container.

l. Raise the lid of shipping container with an overhead hoist and carefully lower lid on shipping container.

Note

Do not allow lid to strike shipping container.

m. Install 4 bolts securing the lid to the container. Torque. Refer to Section VIII, Reference No. 207 for torque value. Lockwire.

n. Pressurize container to 6 to 8 Psig and, using soapy water, check for leaks around welds and at the seal flange.

o. Remove air pressure and install plug in top part of container.

p. Re-stencil container.

SECTION VII
TESTING AFTER FIELD MAINTENANCE

7–1. GENERAL.

a. This section is designed and issued for the guidance of personnel assigned the responsibilities of preparing and testing subject model engines after field maintenance repair, replacement of components, and/or conditioning.

b. The purpose of this instruction is to insure that engines, which have been repaired, are acceptable for another service tour.

c. This section contains test cell requirements, such as, special tools, instruments, etc. It also contains engine test buildup, test cell installation and testing instructions with run schedules which are necessary to prove engines performance, serviceability and quality of the repair performed.

d. It is essential that operating personnel have a thorough knowledge of the correct temperatures, vibration limits, fuel pressures, lube oil pressures, control adjustments, and other important details of engine operation, so that they may be able to recognize quickly any engine defects that may occur; which if not detected may cause serious and extensive damage to the engine. In addition, they should have a general knowledge of the operation of test cell systems, test cell auxiliary power units, etc.

7-2. ARRANGEMENT.

7-3. This section is arranged in such a manner that new personnel, when reading from the beginning to the end, will become familiar with the various phases of engine testing and test equipment, which is listed in proper sequence. Careful study of material will reveal the various phases of testing, test equipment maintenance and calibration which is broken down in line with the laymans ability to master the various phases of this work.

7-4. DEFINITIONS.

7-5. FUNCTIONAL TEST. The functional test consists of a starting check, leakage check, fuel control adjustments and checks for such items as: high speed stop settings, idle speed settings, exhaust gas temperature, and throttle burst acceleration checks. Also, exhaust nozzle adjustments, vibration, oil pressures, and internal noise analysis.

7-6. The functional test can be given to engines installed in any test cell which is capable of supporting and maintaining the engine and its systems; such as: (a) Shaw-Estes Test Cell, S/N 7CAD-732515, Model 168-100 (10,000 lbs. capacity), M168-100 (20,000 lbs. capacity). Technical Order 33D4-6-9-4 and -11 describes this equipment. (b) Jet Engine Run-up Stand, S/N 7CAD-702515. (Technical Order 33D4-6-17-1 describes this equipment.) (c) Universal Portable Jet Engine Run-up Stand, S/N 7CAD-702720. (Technical Order 33D6-16-1 describes this equipment.) Various phases of the FUNCTIONAL TEST can also be checked in the aircraft. However, to employ the full scope of repair and replacement authorized by this technical order, a test stand is required. If the FUNCTIONAL TEST is to be performed in an aircraft to clear minor repairs (see Table XXIX), it must be remembered that test limits contained in this section are for engines being operated in a test cell only, therefore, many limits would have to be modified.

TABLE XXIX. REPAIR VERSUS TYPE OF TEST ENGINE TEST RUN REQUIRED

Repair, Rework or Replacement	Functional Test in Acft	Functional Test Required	Performance Test Required
1. Fuel control linkage	X		
2. External fuel, oil or airlines	X		
3. Main engine bearings		X	
4. Air and oil seals (Labyrinth type)		X	
5. Hydraulic pump drive casing and cover	X		
6. Air inlet section, screens, fairings or island covers	X		
7. Removal of compressor stator assy for inspection and replacement of same	X		
8. Compressor stator blades repair or replacement		X	

TABLE XXIX. REPAIR VERSUS TYPE OF TEST (Cont.)

Repair, Rework or Replacement	Functional Test in Acft	Functional Test Required	Performance Test Required
9. Compressor rotor blades repair			X
10. Compressor rotor replacement			X
11. Compressor front frame		X	
12. Compressor rear frame		X	
13. Combustion chambers, outer (more than three)	X		
14. Combustion chambers, inner (more than three)	X		
15. Transition liners	X		
16. Inner and/or outer band assembly		X	
17. Turbine nozzle (repair)		X	
18. Turbine nozzle (replacement)		X	
19. Turbine shroud ring	X		
20. Turbine frame		X	
21. Lube oil jets	X		
22. Turbine wheel		X	
23. Turbine buckets		X	
24. Internal piping		X	

7–7. PERFORMANCE TEST. The performance test consists of a check and evaluation of the engine's power. This test is scheduled in a sequence with instrument recordings taken at a precise time during a speed setting. The performance test can only be given with a test cell capable of measuring such items as thrust, temperature from —20°F to 2000°F, and exact RPM. The Shaw-Estes model 168–100 or M168–100 is capable of this type test.

7–8. ENGINE TEST RUN REQUIREMENTS.

7–9. GENERAL. The type of test to be given a reworked engine is dependent on the type of rework accomplished; the engine area the rework was accomplished in; and, in some cases, the type of test cell and equipment on hand. Paragraph 7–43 lists type of equipment required to accomplish each type of test run, both FUNCTIONAL and PERFORMANCE. The following paragraphs give the test run requirements necessary to prove various types of rework and/or replacement accomplished.

7–10. FUNCTIONAL TEST. The functional test should be given to all newly received engines, whether they are new or newly overhauled. The functional test shall be given to reworked engines. Refer to Table XXIX which specifies the type of test run required to clear, or prove serviceable the repair or rework accomplished.

7–11. PERFORMANCE TEST. The performance test shall be given to each engine when called for by Table XXIX or when considered necessary in evaluation of an accident or incident where engine's power is involved. Paragraph 7–43 outlines the performance test equipment requirements. Each engine being checked for performance shall be given the FUNCTIONAL TEST prior to the PERFORMANCE TEST to insure proper operation of the controls, etc.

Note

To conserve test cell time, engines may be given the PERFORMANCE TEST in QEC configuration. If QEC is installed during the PERFORMANCE TEST, the alternator, generator and hydraulic pump will not be loaded when recording performance data. This is necessary to minimize their effect on performance, Engines that meet the PERFORMANCE TEST requirements in QEC configuration will be accepted as serviceable. Engines that do not meet the PERFORMANCE TEST requirements in QEC configuration will be re-tested with the special tools (listed in Table XXXII) installed.

7–12. GENERAL AIM OF TESTING.

7–13. The general aim of testing turbo-jet engines is essentially a means of checking the satisfactory operation and performance of the engine; and to provide a means whereby the quality of the rework can be gauged. The minor repaired engine must meet the quality and performance guarantees of a new engine, because it must do the same job. In no other way except by testing and proper evaluation of the test data can the performance capabilities of the engine be determined before it is classed as air worthy.

7–14. REASON FOR TESTING.

7–15. In order that the engine test operator may understand the reasons for engine testing and realize the importance of accomplishing the duties with which he

is charged, it should be emphasized that engine operational tests are as vital as any other phase of field maintenance. In the test cell operator's hands lies the future performance of every engine tested. Many instances have occurred when an engine in perfect mechanical condition prior to test, proved to be in unsatisfactory mechanical condition after the test, resulting in compressor rotor or stator blade damage, overtemperature, overspeeding, vibration, damaged bearings, low power output and unreliable performance. The following paragraphs contain the basic mechanical reasons for engine testing and should be thoroughly understood by personnel charged with responsibility of testing engines.

7-16. PRESTART AND PURGE. The engine is motored over with the starter (without ignition) to insure that oil under pressure is reaching the bearings and also to make sure the engine has been properly assembled and turns over freely. During the engine "rundown" a check is made to insure there is no apparent seal rub, faulty clearances or unusual noises which may have occurred through rough handling during shipping or actually built into the engine during field maintenance assembly.

7-17. VIBRATION. During the test, engines rotational vibration is checked to determine if an unbalance condition exists.

7-18. EXHAUST GAS TEMPERATURE. During test, the engine exhaust gas temperature is set to desired limits, within jet exhaust nozzle area limits, at 100% engine speed.

7-19. TESTING FOR GENERAL SERVICEABILITY.

7-20. Although individual components of the various systems which make up the complete engine are subjected to tests which prove their individual serviceability, engine testing affords an opportunity for making final adjustments to these various components so their performance as an integral part of a complete system can be determined the end product is a complete engine of proven quality.

7-21. TRANSPORTING ENGINE.

7-22. The high noise level associated with jet engine testing usually requires the test site to be located a great distance from the engine maintenance shops. When transporting engines a pneumatic tire dolly should be used which will lessen the possibility of brinelling bearings, etc. The engine should not be towed faster than 5 mph over hard surface roads, or 1 to 2 mph over rough surface roads. The Shaw-Estes test dolly, with its fiber composition wheels should never be used to transport engine from shop to test site.

7-23. TEST LOG SHEET AND ITS FUNCTION.

7-24. GENERAL. (Figure 7-1.) AFTO Form Nr 42 illustrates the engine test log sheet which shall be used by field maintenance for recording observed engine operational data during the testing phase. When properly filled out, the test log will provide a record of the engine test for future reference and shall be documentary proof that the engine was subjected to the prescribed test procedures and schedules. The recorded data must be complete, accurate, neat and written in a legible manner.

7-25. FILLING OUT THE TEST LOG SHEET. Particular steps must be employed carefully in order to make the test log sheet useful and accurate. They are as follows.

a. When engine has been received and scheduled for test cell operation, the operator or his qualified assistant in charge of the cell shall inspect the engine data plates for the assigned serial number, model number, type run required and proper and complete installation of the necessary slave test equipment.

b. Prior to commencement of the test run, the operator or his qualified assistant shall enter the name of the activity, the engine serial number; the fuel specification; oil specification; type of test run required, and calendar data, in the space provided on the test log sheet.

c. Weather conditions, e.g., station barometric pressure wet-dry bulb temperature, vapor pressure and compressor inlet temperature shall be obtained and entered in the spaces provided on the test log sheet. These readings shall be obtained as near the performance test time as possible.

Note

The station barometric pressure recording is only necessary when the PERFORMANCE TEST is given.

d. During the test, the operator and/or his assistant shall record data as called for during the run. All unusual occurrences and repairs made during the test run shall be entered in the REMARKS column of the test log.

e. The test log sheet must be signed by the operator or his assistant and the assigned inspector. The inspector shall also initial and date whether engine was ACCEPTED or REJECTED (if rejected, the reason shall be explained in detail under REMARKS). The test operator and/or his assistant and the inspector will be held equally responsible for the test log sheet being complete, accurate and legible.

7-26. THRUST EVALUATION.

7-27. GENERAL. The following procedures shall be used to calculate engine thrust when a PERFORMANCE TEST is required. Compute the performance for the 100% RPM setting only. The engine must meet the thrust and EGT specified in the applicable performance chart. Rejection is mandatory if engine does not meet the specified requirements. There is no requirement to compute SFC at field maintenance. SFC limits are included for information only.

7-28. THRUST CALCULATING METHOD. Select the perfomance chart applicable (Figures 7-20 thru 7-27) to the engine model being tested and follow the procedure below.

a. Find the minimum allowable thrust for dry air corresponding to the observed compressor inlet temperature and barometric pressure. ("Hg).

AIR FORCE BASE
ORGANIZATION
TEST DATE

FIELD MAINTENANCE TIIRBO JET ENGINE TEST LOG

ENGINE MODEL
ENGINE SERIAL NO.
TEST LOG COMPLETE

	COLUMN NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TIME	TIME OF DAY																				
	DURATION																				
	TOTAL TIME – HOURS																				
RPM	OBSERVED RPM																				
	OBSERVED LO-ROTOR (N1) RPM																				
	OBSERVED HI-ROTOR (N2) RPM																				
	CORRECTED LO-ROTOR (N1) RPM																				
	CORRECTED HI-ROTOR (N2) RPM																				
	RPM FLUCTUATION																				
THRUST	THRUST READ																				
	THRUST ACTUAL																				
	THRUST CORRECTED																				
TEMPERATURE	COMPRESSOR INLET TEMPERATURE – °F																				
	T.P.T. – °F NO. POSITION																				
	T.P.T. – °F NO. POSITION																				
	T.P.T. – °F NO. POSITION																				
	T.P.T. – °F NO. POSITION																				
	T.P.T. AVERAGE CORRECTED – °F																				
	T.P.T. MAX ALLOWANCE – °F																				
	T.P.T. VARIATION – °F																				
	T.P.T. SPREAD – °F																				
PRESSURE	COMPRESSOR INLET PRESSURE – "HG																				
	COMPRESSOR REAR FACE PRESSURE – PSI (J71)																				
	FORWARD TURBINE WHEEL FACE PRESSURE – PSI																				
	ANTI-ICING PRESSURE – PSI																				
FUEL	FUEL INLET PRESSURE – PSI																				
	MAIN FUEL PUMP DISCHARGE PRESSURE – PSI																				
	MANIFOLD PRESSURE – PSI																				
	FUEL BOOST PUMP DISCHARGE PRESSURE – PSI																				
	EMERGENCY FUEL PUMP PRESSURE – PSI																				
OIL	LUBE OIL PRESSURE – PSI																				
	MID-FRAME MAIN OIL PRESSURE – PSI																				
	AUXILIARY GEAR CASE PRESSURE – PSI																				
	SCAVENGE OIL PRESSURE – PSI																				
	OIL INLET TEMPERATURE – °F																				
	OIL OUTLET TEMPERATURE – °F																				
VIBRATION	COMPRESSOR – FORWARD – MILS																				
	COMPRESSOR – AFT – MILS																				
	TURBINE – MILS																				
	ACCESSORY DRIVE ELBOW – MILS																				
MISCELLA-NEOUS	THROTTLE ANGLE – DEGREES																				
	NOZZLE POSITION																				
	INLET GUIDE VANE – DEGREES																				

REMARKS

STARTS					
AUTO			MANUAL		
Fired	Stabilized	EGT	Fired	Stabilized	EGT

ACCELERATIONS	EGT	TIME
NO. 1		
NO. 2		
NO. 3		

EMERGENCY RECOVERY CHECK	TIME
NO. 1	
NO. 2	

COMPRESSOR BLEED VALVE CHECK		
LEFT CLOSE	RPM	°F
RIGHT CLOSE	RPM	°F
RIGHT OPEN	RPM	°F
LEFT OPEN	RPM	°F

INLET GUIDE VANE CHECK	
OPEN	RPM
CLOSE	RPM

OBSERVED TIME	
INSTALLATION	
RUN IN	
REPAIRS	
REMOVAL	
TOTAL TIME	

WEATHER			
PERIOD NO.			
DRY BULB – °F			
WET BULB – °F			
VAPOR PRESSURE – "HG			
TRUE BAR – "HG			

THRUST CORRECTIONS			
RPM		MIN REQUIRED THRUST	
THRUST READ		VAPOR CORRECTION	
DEVICE CORRECTION		MIN REQ CORRECTION	
TARE		VARIATION	
ACTUAL THRUST		ACT S.L. THRUST	

OIL CONSUMPTION AND TARE			
	START	END	AVERAGE CONSUMPTION
OIL			
TARE			

CONTROL SETTINGS
MAIN IDLE RPM
EMERGENCY IDLE RPM
MAX MAIN RPM
MAX EMERGENCY RPM

MISCELLANEOUS DATA
ROTOR COAST TIME
FUEL SPEC NO.
OIL SPEC NO.
ENGINE ACCEPTED – DATE
ENGINE REJECTED – DATE

OPERATING PERSONNEL
OPERATOR
RECORDER

AFTO FORM MAR 58, 42

PREVIOUS EDITIONS OF THIS FORM MAY BE USED.

Figure 7-1. AFTO Form 42

J47-26139-0-A2

b. Find the thrust vapor pressure correction (top line of vapor pressure correction chart at the top of the performance chart) and subtract the correction from the results obtained in the preceding paragraph, to obtain the minimum allowable thrust for observed conditions. Record this result on the log sheet.

c. From the actual thrust value, subtract the minimum allowable thrust (value determined in the preceding paragraph) and multiply the difference by 100, then divide the results by the minimum allowable thrust value to obtain the percent variation from the minimum allowable thrust. Record this percent on the log sheet.

d. The percent variation from minimum allowable thrust must be a plus value otherwise the engine will be rejected.

e. Find the "Standard Sea Level Thrust Value Chart," see Table XXX, for the type model engine being tested. The chart contains two columns, one for percent above minimum allowable thrust and one for standard dry sea level thrust. In the column headed "% above minimum allowable" locate the percent applicable (value obtained in Paragraph c. above) and directly opposite will be the corresponding standard dry sea level value. Record this value on the log sheet, and enter the new standard sea level thrust on AFTO Form 829.

7-29. EXHAUST GAS TEMPERATURE. There are three steps in the finding of the average allowable exhaust gas temperature, they are as follows:

a. Find the maximum allowable exhaust gas temperature for dry air. This is the maximum allowable exhaust gas temperature for dry air and must be corrected for vapor pressure.

b. Determine the exhaust gas temperature vapor pressure correction from the vapor correction chart at the top of the performance chart. Subtract this correction value from the maximum allowable exhaust gas temperature obtained in Step a. above. This new value is the

TABLE XXX. THRUST FOR STANDARD DRY SEA LEVEL CONDITIONS

% Above Min. Allow.	Std. Dry Sea Level Thrust -23	-25 & -27	% Above Min. Allow.	Std. Dry Sea Level Thrust -23	-25 & -27	% Above Min. Allow.	Std. Dry Sea Level Thrust -23	-25 & -27
0.1	5916	5976	3.4	6111	6173	6.7	6306	6370
0.2	5922	5982	3.5	6117	6179	6.8	6312	6376
0.3	5928	5988	3.6	6123	6185	6.9	6318	6382
0.4	5934	5994	3.7	6129	6191	7.0	6324	6388
0.5	5940	6000	3.8	6135	6197	7.1	6330	6394
0.6	5945	6006	3.9	6140	6203	7.2	6336	6400
0.7	5951	6012	4.0	6146	6209	7.3	6341	6406
0.8	5957	6018	4.1	6152	6215	7.4	6347	6412
0.9	5963	6024	4.2	6158	6221	7.5	6353	6418
1.0	5969	6030	4.3	6164	6227	7.6	6359	6424
1.1	5975	6036	4.4	6170	6233	7.7	6365	6430
1.2	5981	6042	4.5	6176	6239	7.8	6371	6436
1.3	5987	6048	4.6	6182	6245	7.9	6377	6442
1.4	5993	6054	4.7	6188	6251	8.0	6383	6448
1.5	5999	6060	4.8	6194	6257	8.1	6389	6454
1.6	6005	6066	4.9	6200	6263	8.2	6395	6460
1.7	6010	6071	5.0	6206	6269	8.3	6401	6466
1.8	6016	6077	5.1	6212	6274	8.4	6406	6471
1.9	6022	6083	5.2	6218	6280	8.5	6412	6477
2.0	6028	6089	5.3	6223	6286	8.6	6418	6483
2.1	6034	6095	5.4	6229	6292	8.7	6424	6489
2.2	6040	6101	5.5	6235	6298	8.8	6430	6495
2.3	6046	6107	5.6	6241	6304	8.9	6436	6509
2.4	6052	6113	5.7	6247	6310	9.0	6442	6507
2.5	6058	6119	5.8	6253	6316	9.1	6448	6513
2.6	6064	6125	5.9	6259	6322	9.2	6454	6519
2.7	6070	6131	6.0	6265	6328	9.3	6460	6525
2.8	6075	6137	6.1	6270	6334	9.4	6466	6531
2.9	6081	6143	6.2	6276	6340	9.5	6471	6537
3.0	6087	6149	6.3	6282	6346	9.6	6477	6543
3.1	6093	6155	6.4	6288	6352	9.7	6483	6549
3.2	6099	6161	6.5	6294	6358	9.8	6489	6555
3.3	6105	6167	6.6	6300	6364	9.9	6495	6561

allowable exhaust gas temperature for observed conditions. Record this on the log sheet.

c. Subtract the average observed exhaust gas temperature from the value obtained in Step b. above (corrected maximum allowable exhaust gas temperature). If the observed average exhaust gas temperature noted during test is less than the new maximum allowable exhaust gas temperature, the engine's exhaust gas temperature is acceptable.

7–30. TEST CELL AND EQUIPMENT REQUIREMENTS.

7–31. GENERAL. In order that the engine testing program may be successfully accomplished with a minimum of component failures, it shall be necessary to establish maintenance and inspection procedures for the various slave equipment and special tools used in the test cells. Therefore, a suitable preventative maintenance and inspection chart shall be compiled by each individual organization based on past experience, this technical order, and manufacturer's recommendations covering the components of the test cell and various supporting systems outlined in this instruction.

7–32. SPECIAL TOOLS AND TEST EQUIPMENT.

7–33. Special tools and equipment required for testing depend on the type test run to be given. Table XXXI gives the tool and equipment requirements necessary to accomplish the FUNCTIONAL TEST. Special tools and equipment necessary to give the FUNCTIONAL TEST in an aircraft are not listed in this instruction. Refer to the applicable aircraft handbook. Table XXXII gives the tool and equipment requirements necessary to accomplish the PERFORMANCE TEST. (Refer to paragraph 7–11 for QEC testing.)

7–34. EQUIPMENT CALIBRATION AND CONDITION INSPECTION.

TABLE XXXI. TOOLS REQUIRED FOR FUNCTIONAL TEST

Nomenclature	Tool or USAF Stock NR	Applicable to Model –23	–25	–27
*Tailpipe	P/N 1C728 (7CGE–1C728)	X	X	X
*Nozzle Assembly	P/N 9482208 (7CAD–593600)	X	X	X
Ring Assembly	P/N 51823K or 51823J	X	X	X
Cone Assembly	P/N 9482151 or 7021E45	X	X	X
	P/N 702R56		X	
	P/N 5–8E527 or 7032R80G1			X
Inlet Air Thermocouple	Iron-Constantan Type "Y"	X	X	X
Exhaust Thermocouples	Chromel-alumel	X	X	X

*Aircraft equipment may also be used.

TABLE XXXII. SPECIAL TOOLS REQUIRED FOR PERFORMANCE TEST

Nomenclature	Tool or USAF Stock NR	Applicable to Model –23	–25	–27
Bellmouth	P/N 1C825 (4920–397–1772) or equal	X	X	X
Nose Fairing	P/N 1C891 (4920–398–1276)		X	X
	P/N 1C827	X	X	X
	P/N 1C893 (7CAD–805649)	X		
Tailpipe	P/N 1C728 (7CGE–1C728)	X	X	X
Nozzle Assembly	P/N 9482208 (7CAD–593600)	X	X	X
Ring Assembly	P/N 51823K or 51823J	X	X	X
Cone Assembly	P/N 9482151 or 7021E45	X	X	X
	P/N 702R56		X	
	P/N 508E527 or 7032R80G1			X
Inlet Air Thermocouple Assembly	P/N 1C1633 (4920–041–1204)	X	X	X

7-35. JET NOZZLE. A nozzle, being a precision instrument, should be handled with extreme care. Damage to the yoke, in any way, may result in incorrect calibration and performance.

a. To minimize the possibility of corrosion, nozzles should be stored in a dry room.

b. Lubrication is absolutely essential. The threads and joints will be lubricated with a high temperature grease. It shall be the responsibility of the operator to keep these parts properly lubricated. Plastilube Nr 1, produced by the Warren Refining and Chemical Company, Cleveland, Ohio (or the equivalent) is recommended.

Note

Care will be exercised in the handling of jet nozzles and a suitable stand or rack will be provided for storing nozzles while not in use.

c. Variable jet nozzles will be calibrated every 90 days or whenever there are indications of improper performance, or whenever nozzles have been disassembled. Technical Order 2J-J1-10 contains calibration instructions for variable jet nozzles.

7-36. THRUST SYSTEM. Calibration and condition inspection instructions for the Shaw-Estes model 168-100 and M168-100 are contained in Technical Order 33D4-6-9-11. Technical Order 33D4-6-2-501 gives operating instructions for the SR-4 calibration kit used in conjunction with test cell thrust system calibration.

7-37. MISCELLANEOUS EQUIPMENT INSPECTION. Refer to the applicable handbooks for special instructions pertaining to the equipment.

7-38. INSTRUMENTATION CALIBRATION.

7-39. GENERAL. The outlined calibration procedures are directed to personnel assigned the responsibility of maintaining and calibrating test cell instruments. Calibration procedures issued by the equipment prime AMA or AF Depot will supersede information contained in this technical order.

7-40. PRESSURE INDICATORS. In conjunction with calibration performed at intervals of one calendar month, pressure check all pressure gage systems to a pressure equal to 3/4 instrument capacity or 20 psig whichever is lower. Satisfactory system shall show no pressure loss during one minute under these conditions. In addition, the following gages shall be calibrated in conjunction with the specific checks made once each calendar month.

a. Oil pressure.

b. Small slot pressure.

c. Fuel inlet pressure.

All other gages not covered by the above shall be calibrated at intervals not to exceed 3 months.

7-41. TEMPERATURE INDICATORS. The potentiometers batteries and action shall be inspected and adjusted as follows:

a. Iron-constantan and chromel-alumel potentiometer balance shall be adjusted and serviced using the procedure prescribed by the applicable technical order or service manual once each calendar month.

b. All thermocouples and their systems which are a permanent part of the test cell equipment shall be given a continuity check. This check shall be conducted at the cold junction terminals. All thermocouples and their leads which do not evidence circuit continuity or which reflect a resistance in excess of 100 ohms shall be repaired or replaced. The systems shall also be given a SHORT check to ascertain that neither of the wires are making contact with the thermocouple sheath above the hot junction. Those shorted out shall be replaced.

Note

Test cell incorporating temperature indicating system identical to the aircraft shall be calibrated and inspected in accordance with applicable instructions.

c. Compressor inlet air temperature thermocouples shall be removed from use once each calendar month and checked as follows: attach thermocouple to a serviceable potentiometer indicator. Apply localized heat, as with a soldering iron or oven which is designed for this purpose, to the thermocouple hot junction. Those thermocouples not showing a rapid unhesitant response shall be replaced or repaired.

7-42. VIBRATION EQUIPMENT CALIBRATION. Calibration, maintenance, and operating instructions applicable to vibration meter, stock No. 7CAC-040900, Type 1-110BM8, are contained in T.O. 33D4-6-12-1. (Refer to T.O. 33A1-11-9-3 if using 1-117 vibration meter.) This technical order will be read by test personnel prior to instrument operation. The vibration meter shall be removed from service each calendar month and recalibrated prior to use. Calibration instructions applicable to the Air Force approved pickup, part No. 7CAD-631724, Type 4-102A, are contained in T.O. 33D1-11-8-3. They will be removed from service each calendar month and recalibrated accordingly, prior to use.

Note

If calibration equipment is not on hand, it will be necessary to have the calibration accomplished at the nearest AMA that is capable of such calibration.

7-43. TEST INSTRUMENTATION.

7-44. GENERAL. The safe, economical, and reliable testing of subject model engines is absolutely dependent upon the use of quality instruments. It shall be necessary to maintain a high standard of accuracy and operation.

7-45. INSTRUMENT REQUIREMENTS. Instrument requirements depends on the type test run to be given. Listed in the following paragraphs are various type instruments required; range necessary, and where the

item to measure is located on the engine.

7-46. PRESSURE TYPE INSTRUMENTS. The following is a list of pressure sensing indicators required for the test run indicated.

a. Fuel manifold Pressure (figure 7-2). — Required for the functional and performance test. To be taken from pressure tap provided on the flow divider. Pressure shall be read on a gage calibrated in psi with a range of 0 to 600 psi.

b. Lube Oil Pressure (figure 7-3). — Required for the functional and performance test. To be taken at the fitting provided on the pressure transmitter down stream from the oil filter and check valve. Pressure shall be read on a gage calibrated in psi with a range of 0 to 60 psi.

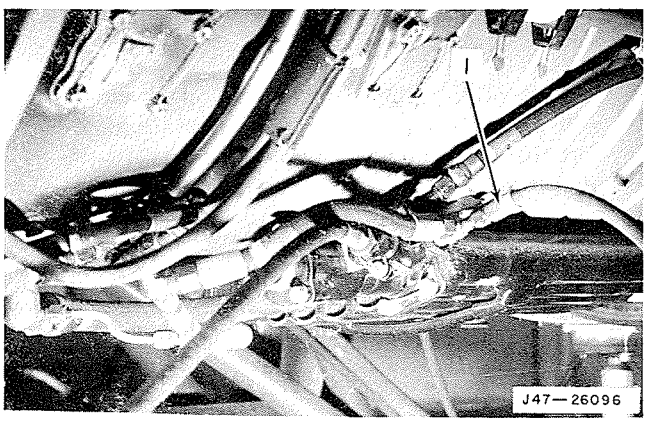
c. Anti-Icing Pressure. — To be taken by installing a slave "T" fitting AN824-8 in either the Nr 1 or 4 island manifold tube P/N 131B444-1. Read pressure on a gage calibrated in psi with a range of 0 to 60 psi. Required for the functional and performance test.

7-47. TEMPERATURE MEASURING INSTRUMENTS. The following is a list of temperature indicators required for the test run indicated.

a. Compressor Inlet Temperature (figure 7-4). — Required for functional and performance test. To be taken from four open tip type thermocouples (iron-constantan) located in the bellmouth thermocouple adapters, they shall be read on a potentiometer indicator, dual range dial type, S/N 7CAC-650092-5 (range 0-600°F) or equivalent.

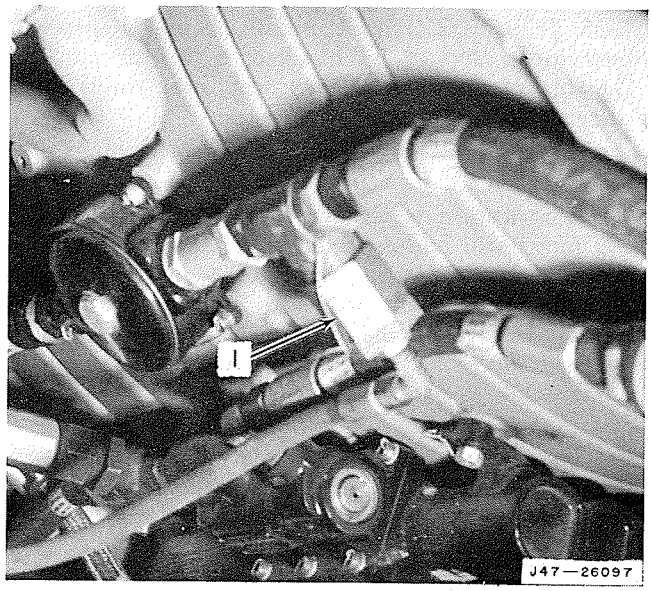
Note

Organizations having a run-up test stand may not have a bellmouth, and will not have the potentiometer indicator. It will be necessary to implement the cell with a temperature system to indicate either outside air temperature (OAT) or compressor inlet temperature (CIT). Since acceleration rate limits, EGT, limits, and emergency high speed requirements are a function of CIT; it is recommended that a correlation be made between CIT and OAT if OAT is to be used in determining desired limits and settings.



1. Small Slot Pressure Tap

Figure 7-2. Small Slot Manifold Connection



1. Oil Pressure Connection

Figure 7-3. Oil Pressure Tap

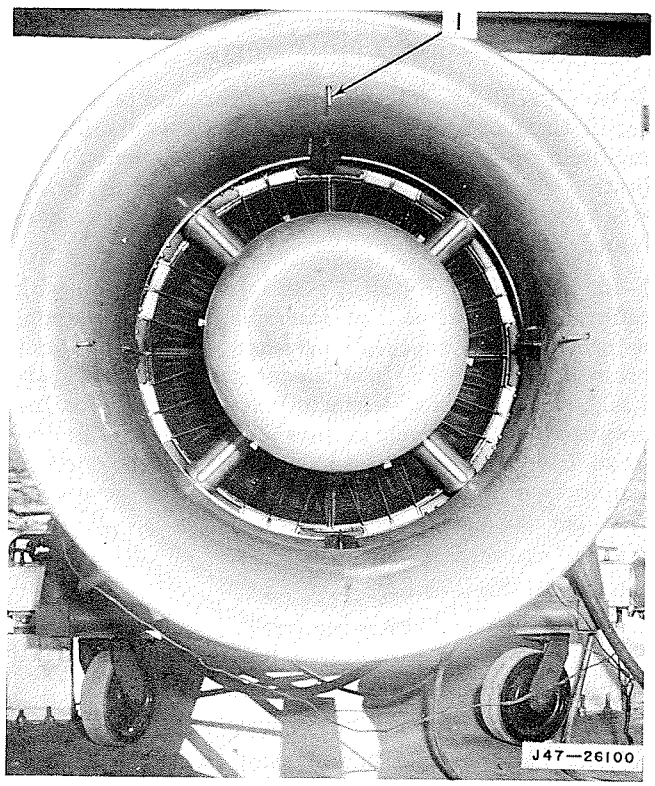


Figure 7-4. Compressor Inlet Temperature T/C

b. Engine Oil Inlet Temperature. — Required during the functional and performance test. To be taken from one closed tip type thermocouple inserted in the oil inlet line near the engine. Read temperature on the indicator mentioned in Item a. above. When using a run-up stand it will be necessary to implement the entire system.

c. Exhaust Gas Temperature (EGT) (figure 7-5). — Required during the functional and performance test. To be taken from four parallel (chromel-alumel) thermocouples located in the tailpipe, 30 to 31 inches aft of tailcone exhaust flange on 45 degree planes, and immersed two inches into the exhaust gas stream. Read each of the four temperatures on the potentiometer indicator, dual range, dial type, S/N 7CAC-650092-5 (range 0° to 2400°F) or equivalent. During the functional test on a run-up stand the EGT shall be read on a K-7 type indicator or equivalent, range 0 to 1000°C. The thermocouple circuitry must be calibrated to the exact resistance as called for by the indicator being used. This resistance is usually 8 ohms.

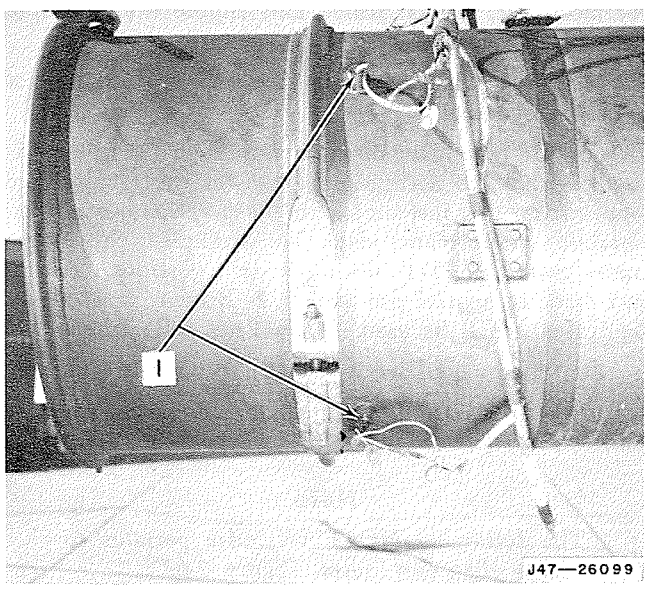
7-48. ENGINE SPEED INDICATION. The following is a list of the required RPM indicating equipment for the test run indicated.

a. FUNCTIONAL TEST given with run-up stand. Speed indicator necessary is indicator, Electric Tachometer, Type E-21-A, 4200 RPM, (Kollman Instrument Corp., or equal). If functional run is given in the Shaw-Estes facility the equipment listed in Item b. below will suffice.

b. PERFORMANCE TEST speed indicating equipment necessary, is as follows:

(1) Generator, Standard Frequency, (American Time Products, Inc., New York or equal). P/N 2121A, to insure 60 cycle ac power to the strobotron tube in the stroboscope tachometer.

(2) Unit, Tachometer Stroboscope and Power Pack (Standard Electric Time Co., Springfield, Mass., or equal), P/N WD-10342-C.



1. Tailpipe T/C

Figure 7-5. Tailpipe T/C

7-49. STOPWATCH TIMER. A manually operated timer shall be furnished each run-up stand and will be used in conjunction with the FUNCTIONAL RUN. The timer incorporated in unit (Item b. (2) above), is adequate for either the functional or performance test when using the Shaw-Estes facility.

7-50. VIBRATION. The following list of equipment is required for measuring engine vibration during the FUNCTIONAL and PERFORMANCE TESTS.

a. Two each velocity pick-ups, Type 4-102A, S/N 7CAD-631724 or equivalent.

Note

The Air Force approved pickup, Type 4-102A shall be supplied with a means of cooling, i.e., shop air or water, to insure that pick-ups are not subjected to a temperature above 150°F. (70 to 120°F preferred operating range). Exceeding the 150°F will change the sensitivity and possibly damage the pickup.

b. One compressor front frame mounting bracket.

c. One turbine casing mounting bracket assembly.

d. One vibration meter, Type 1-110BM8, S/N 7CAC-040900 (or Type 1-117 #381, S/N 7CAD-526162) the 1-110BM8 shall be operated in the Nr 1 filter position during all testing of J47 series engines. If an alternate meter is used, the filtering arrangement must be equivalent to the above mentioned Nr 1 filter response characteristics. (Refer to Technical Order 33D4-6-12-1, Maintenance and Operating Instructions). This technical order will be read by all personnel prior to instrument operation.

Note

Vibration pickups shall be mounted in accordance with instructions contained in this section.

7-51. THRUST. Thrust measurement when required (PERFORMANCE TEST), can only be given in the Shaw-Estes test facility. Refer to Technical Order 33D4-6-9-4 and -11, which gives the required equipment.

7-52. TEST CELL SYSTEM REQUIREMENTS.

7-53. FUEL SYSTEM. The test facility fuel system design and construction is particularly important. Improperly constructed systems, including sharp bends, will result in the formation of air in the lines. The number of connections should be reduced to a minimum and extreme care should be exercised to insure that sharp bends in the fuel lines are avoided. Sufficient flexibility should be provided in the lines to eliminate

the possibility of breakage due to vibration of the engine, since their failure will result in the escape of fuel and subsequent fire hazard. The Shaw-Estes test facility fuel system consists primarily of the 1000 gallon fuel tank, fuel filters, flow meter, boost pumps, pressure regulator valve and shut-off valves arranged to supply a constant supply of fuel to the engine. The run-up stand P/N 7CAD-702715 and 702720 do not have the fuel supply tank, boost pump or fuel filters. Therefore, it will be necessary to implement the stands with adequate equipment. The tank must be large enough capacity to support the engine functional test requirements. The fuel system shall incorporate an adequate number of 10 micron filter elements, to allow maximum fuel flow within fuel inlet pressure limits specified in this instruction. The fuel system shall incorporate a boost pump to supply the engine with an inlet pressure within limits specified in this instruction.

7-54. ENGINE AND ACCESSORIES DRAIN REQUIREMENTS. Provide a means for discharge of overboard drainage of fuel from the engine and accessories. Lines shall be installed in such a manner that they will discharge fuel a sufficient distance from the engine to eliminate possible fire hazard.

7-55. OIL SYSTEM. Refer to the applicable technical order pertaining to test stand being used.

7-56. ELECTRICAL SYSTEM.

7-57. RECTIFIER. Two are required, one 1000 amps, 24 volt dc for each test cell to start engine, and one rectifier approximately 100 amp continuous shall also be supplied each test cell to supply 22 to 28 volts dc for the following accessories and test cell equipment.

a. Compressor air inlet screens.

b. Anti-icing air valve.

c. Ignition.

d. Emergency fuel control solenoid by-pass valve (-27).

e. Main fuel system compressor discharge pressure bleed valve solenoid (-27 model only).

f. Acceleration variable compressor discharge bleed valve solenoid (-23 and -25 models only).

g. Ignition relay. (Test equipment).

h. Starter controller. (Test equipment).

i. Shunt field relay. (Test equipment).

7-58. ALTERNATOR POWER SUPPLY. Supply 115 volt, 60 cycle to test cell for the following instruments.

a. Temperature indicating potentiometer. (Shaw-Estes cell).

b. Thrust indicating instrument. (Shaw-Estes cell).

c. Vibration amplifier instrument.

d. Strobo-tachometer panel power pack. Furnish the strobotron tube 60 cycle controlled frequency to insure strobo-tachometer accuracy. (Shaw-Estes).

7-59. TEST EQUIPMENT CIRCUITS AND COMPONENTS. The following list of electrical circuit components, i.e., switches, indicating lights, relays and instruments or their equivalents are recommended for testing after field maintenance repair. Refer to Figures 7-6 and 7-7 which are included in this instruction for informational purposes only. The number assigned each relay, switch, etc., coincides with assigned number called out in the wiring schematic indicated.

a. Wiring schematic, (Figure 7-6, applicable to the -23, -25, and -25A model engines).

(1) Compressor air inlet screen switch (OPEN-CLOSED), Type MS 35058-4.

(2) Anti-icing air switch, (ON-OFF), Type MS 35058-1.

(3) Ignition cut-off switch (OFF-ON), Type MS 35058-1.

(4) Starting switch (ON-OFF), Type MS 35058-2.

(5) Emergency stop start switch, (Type MS 35058-3 or MS 25089-2 or a commercial GE. CR 2940-AH101B.

(6) Ignition test switch, (NORMAL-TEST), Type MS 35058-2.

(7) Ignition relay, single pole single throw, Type AN 3320-1.

(8) Shunt field relay, single pole single throw, Type AN 3320-1.

(9) Starter controller for automatic drop-out at 235 $\pm$ 15 amperes.

(10) Tachometer panel, S/N 7CAD-NL-84066.

(11) Precision indicating temperature potentiometer, S/N 7CAC-650092-5. (Shaw-Estes cell).

(12) Use thermocouple lead wire between precision potentiometer, pyrometer (if pyrometer indicator is desired, suggest use of S/N 7CAD-672828, range 0 to 2500°F, non-control millavolt type for chromel-alumel thermocouple, 6 inch scale) and engine thermocouple assembly. (Shaw-Estes cell).

(13) Make ground connection between engine test and control panel.

(14) If pyrometer mentioned in Item (12) above is used, it shall be necessary to transfer the temperature signal from this instrument to the potentiometer when obtaining performance data. To accomplish this: pyrometer switch, 2 PDT locking in two postions, no contact made in neutral position. P/N Brown Nr 17283 or equivalent, shall be used. (Shaw-Estes cell).

(15) Pyrometer, see Item (12) above.

(16) Acceleration compressor discharge pressure bleed valve, (BLEED-ON-OFF) Type MS 35058-1.

Note

The following NOTE reference pertains to wiring diagrams notes, Figure 7-6.

A. Automatic drop-out starting controller will not function properly if shunt field relay (Item Nr 8) is not installed, also better cranking characteristics are obtained.

(4) Thermocouple leads, such as exhaust gas temperature, compressor inlet air temperature, engine oil inlet and outlet temperature.

(5) Vibration pickups to their respective lead.

f. Connect the following service connections:

(1) Fuel supply to engine fuel pump inlet adapter (figure 7-11), after completing prestart adjustments and checks.

(2) Oil supply to the engine inlet adapter (figure 7-12).

(3) Oil return from engine (figure 7-13).

(4) Cooling water or air to the turbine vibration pickup (figure 7-14) type 4-102A to insure operating temperatures below 65°C (150°F).

g. Connect the following pressure sensing connections.

(1) Small slot fuel pressure (figure 7-2).
(2) Main fuel pump pressure, if desired.
(3) Emergency fuel pressure, (-27 model) if desired.
(4) Engine fuel supply inlet pressure.
(5) Variable control oil pressure, if desired.
(6) Engine lube oil pressure (figure 7-3).
(7) Anti-icing air pressure.
(8) Aft frame vacuum pressure (One time requirement, see Note below):

Note

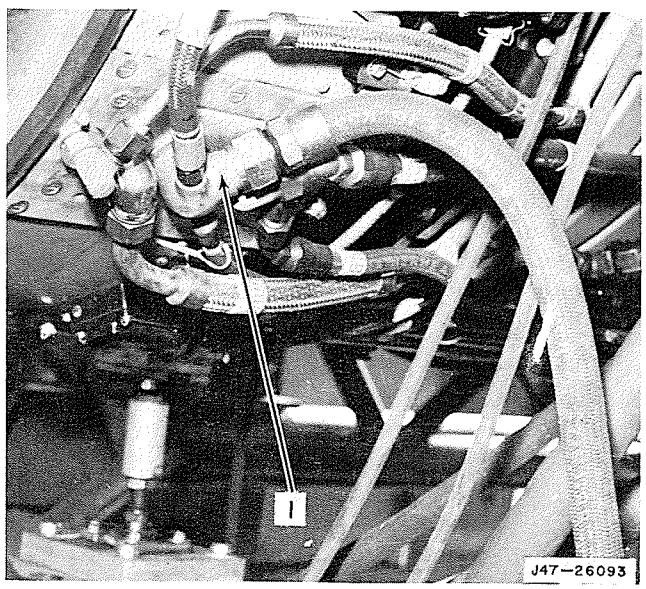
Field test cells are not equipped to measure aft frame vacuum pressure. Therefore, the aft frame vacuum aspirator pressure adjusting valve (figure 7-15, item 3) should be permanently set, using Test Set, 1C1749, (figure 7-16A) to obtain a pressure within the turbine frame of 0 to minus 6 inches H_2O at 100% RPM. Once the output of the aspirator is established, the regulating valve will be permanently secured in that position. Continued measurement of this pressure is not required, except as required for trouble shooting purposes.

h. Install the slave engine test bellmouth.

i. Service the engine lube oil supply tank with oil conforming to Air Force Specification MIL-O-6081.

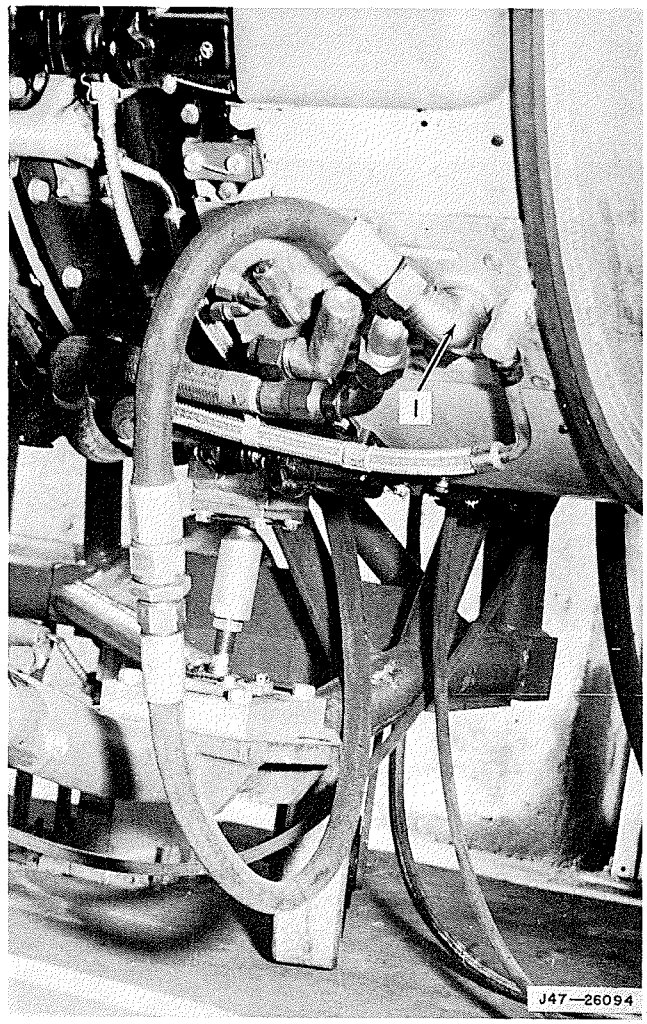
j. Check available fuel supply, and specific gravity. Fuel to be used shall conform to Air Force Specification MIL-F-5624B, Grade JP-4.

7-73. TEST LIMITS AND SPECIAL INSTRUCTIONS.



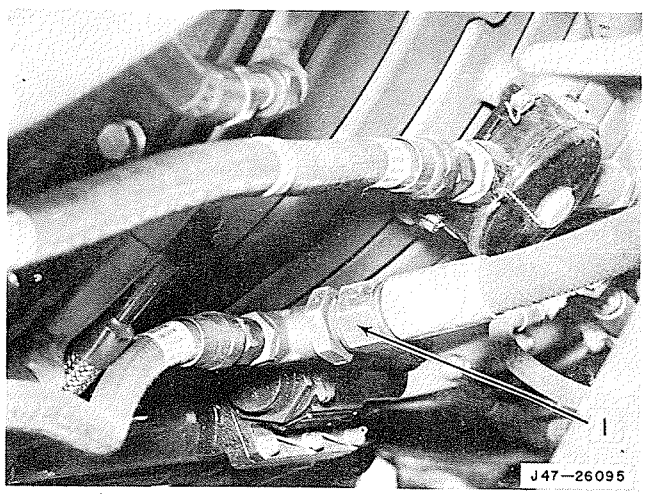
1. Fuel Inlet

Figure 7-11. Fuel Inlet Connection



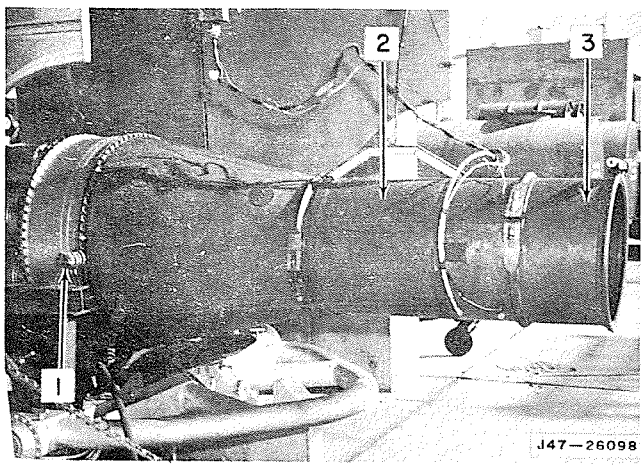
1. Oil Inlet

Figure 7-12. Oil Inlet Connection



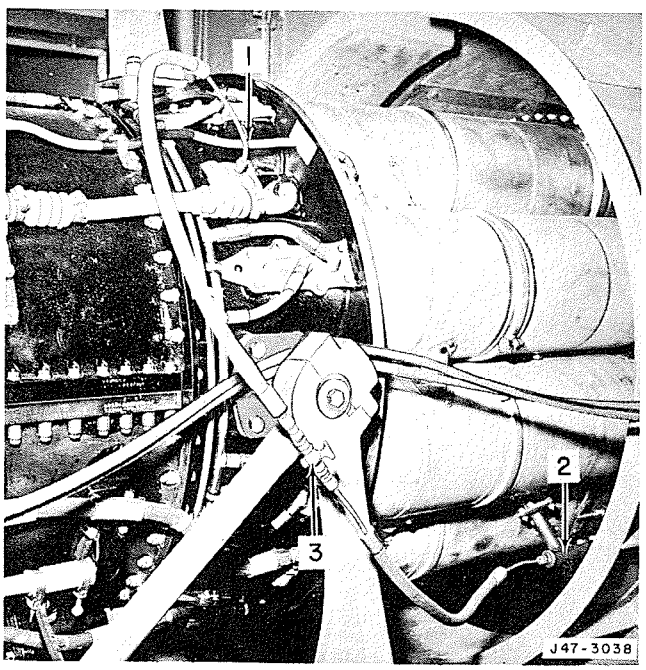
1. Oil Outlet

Figure 7-13. Scavenge Oil Outlet Connection



1. Turbine Pickup
2. Tailpipe
3. Variable Nozzle

Figure 7–14. Turbine Pickup, Tailpipe and Nozzle Assembly



1. Twelfth Stage Takeoff Part
2. Aft Frame Breather
3. Pressure Adjusting Valve

Figure 7–15. Aft Frame Vacuum Hook Up

7–74. EXHAUST GAS TEMPERATURE. The maximum allowable exhaust gas temperature during all operating conditions is shown in Figure 7–16 and Table XXXIII.

a. The maximum exhaust gas temperature spread during stabilized operation shall not exceed 55°C (100°F) for military speeds, 70°C (125°F) for normal speeds, and 110°C (200°F) for idle speed.

b. Approximately 5 to 10 minutes operation at speeds between 96 and 100 percent may be required to permit full stabilization of the exhaust gas temperature before 100 percent RPM can be reached.

7–75. COMPRESSOR INLET TEMPERATURE (CIT). The span of observed inlet temperature readings must not exceed 8°F during any one reading.

7–76. FUEL REQUIREMENTS AND LIMITS.

7–77. FUEL SPECIFICATIONS. The fuel used during the test shall conform to Air Force Specification MIL–F–5624, Grade JP-3 or JP-4.

7–78. FUEL INLET PRESSURE. Maintain fuel pressure supplied to the engine inlet between 5 psig to 25 psig at all times.

7–79. SMALL SLOT FUEL PRESSURE FLUCTUATIONS. The maximum allowable small slot fuel pressure fluctuation during steady state operation is ± 25 psig with permissible occasional peaks to ± 50 psig.

7–80. LUBE OIL REQUIREMENTS AND LIMITS.

7–81. LUBE OIL SPECIFICATION. The lube oil used during the test run shall conform to Air Force Specification MIL-O-6081A, Grade 1010 or 1005. The grade used is dependent on outside air temperature. Use Grade 1010 above + 20°F. Use either grade between —20°F to + 20°F. Use Grade 1005 below —20°F.

Note

There is no requirement for the operational corrosion treatment of subject model engines lube oil system. Therefore, engines main fuel regulator shall not be isolated from the engine oil system as in the past.

7–82. LUBE OIL PRESSURE LIMITS. Oil pressure must be as shown in Table XXXIIIA. During cold weather operation, oil pressure may exceed limits until oil temperature reaches normal.

CAUTION

The oil pressure should increase as the engine speed increases. During normal stabilized operation, an increase of 3 to 10 psig in oil pressure indicates a partial stoppage in the oil system downstream of the pressure tap. This partial stoppage may be caused by a

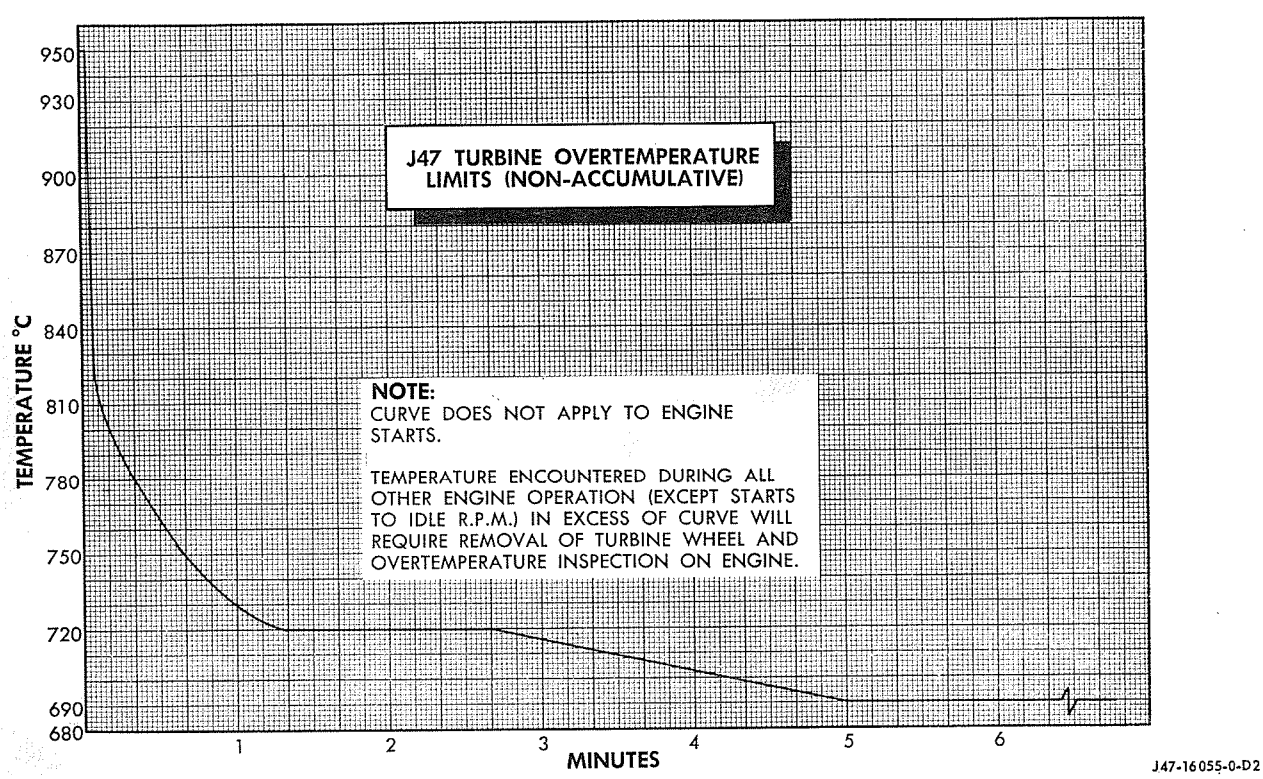
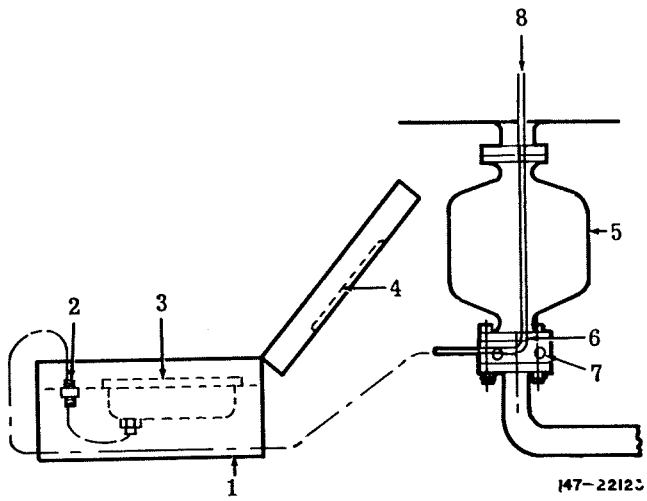


Figure 7-16. Overtemperature Limits for J47 Engines



1. Carrying Case
2. Connector
3. Vacuum Gage
4. Instruction Sheet
5. Breather Assembly
6. Tube to Turbine Frame
7. Static Pressure Tap
8. Inside Turbine Frame

Figure 7-16A. Turbine Frame Pressure Test Using Test Set 1C1749

TABLE XXXIII. EXHAUST GAS TEMPERATURE LIMITS

Operation	Conditions to be Recorded	Cell Operator Action	Maintenance Action (1)
Engine starts up to idle speed within 2 minutes.	Temperature exceeds 950°C (1740°F)	Record time and temperature on AFTO Form 13, or a suitable authorized form	Record time and temperature on AFTO Form 44. Perform overtemperature inspection on engine. Remove turbine wheel and return to overhaul depot for inspection.
All other operations.	Limits in excess of the following: (a) 800°C (1470°F) for more than 2 seconds. (b) 750°C (1380°F) to 800°C (1470°F) for more than 10 seconds. (c) 690°C (1275°F) to 750°C (1380°F) for more than 40 seconds.	Record time and temperature on AFTO Form 13, or a suitable authorized form	Refer to figure 7-16. If it is determined that an overtemperature has occurred, record time and temperature on AFTO Form 44. Perform overtemperature on AFTO Form 44. Perform overtemperature inspection on engine. Remove turbine wheel and return to overhaul depot for inspection.
Disruption of cooling air flow to one or both sides of the turbine wheel.	Record cause: 1. Duration of engine stall exceeding 40 seconds. 2. Duration of engine stall time unknown. 3. Ruptured bellows. 4. Broken or loose cooling air lines. 5. Rubbing of baffles/deflectors on turbine wheel.	Record cause on AFTO Form 42, or suitable authorized form	Record cause on AFTO Form 44. Replace No. 4 bearing. Remove turbine wheel and return to overhaul depot for inspection.

(1) Refer to Section IV, Turbine Wheel Inspection and Repair.

clogged jet and must be investigated. The oil pressure at any speed must not be less than the pressure at a lower speed if the temperature is the same.

7-83. LUBE OIL PRESSURE FLUCTUATION LIMIT. An oil pressure fluctuation of + or - 3 psig is acceptable during steady state operation at any speed.

7-84. LUBE OIL CONSUMPTION LIMIT. Maximum allowable oil consumption is 2.5 pph. Refer to paragraphs 7-109j and 7-126h for checking oil consumption.

7-84A. LUBE OIL TEMPERATURE. The maximum lube oil temperature shall not exceed 158°F.

7-85. VIBRATION LIMITS. Vibration readings shall be taken during all stabilized running conditions with the following maximum limits applying.

NOTE

When using vibration meter, Type 1-110BM8 or 1-117, the filter must be in the No. 1 (30 cps) position during all testing. If an equivalent meter is used, it shall be necessary to operate meter with a filter arrangement similar to above-mentioned filter response characteristic.

a. Vibration shall not exceed 5 mils at any stabilized speed ranging from IDLE to TAKE-OFF speed.

TABLE XXXIIIA. LUBE OIL PRESSURE LIMITS

Power Condition	RPM %	RPM Actual	Max. PSIG	Min. PSIG	Normal Range PSIG
Take-off	100.0	7950	22	10	13 - 19
Idle	37.7	3000	8	Pos Ind	1 - 3
Starting	---	--	--	Pos Ind	1 - 3

NOTE

The 5 mil limit is steady state vibrations, not flicks or peaks noted on the indicator which are caused by test stand, etc., and should not be considered part of the engine vibration. It shall be necessary for the person testing the engine to determine whether the instruments are reading steady state vibration or instrument "flicks".

b. If excessive vibration is noted during transient speed from IDLE to TAKE-OFF rated speed, the speed will be allowed to stabilize at that point and the steady state vibration checked. Rejection is mandatory, if steady state maximum limit is exceeded.

7-86. SPEED CONTROLS. (Performance Test Only.) During speed settings requiring the use of the stroboscope tachometer, the thrust, inlet air temperature and EGT will be taken simultaneously within 10 seconds when the stroboscope disc applicable spots appear stopped or are not moving in either direction at a rate of more than one RPM.

7–87. TACHOMETER CALIBRATION. (Shaw-Estes Test Cell.)

Note

Correct speeds read from the tachometer when operating at 7953 RPM and when operating at idle 3030 RPM for tachometer error before recording on test log sheet.

a. Make an accurate check of the tachometer error at 7953 RPM. When the 36 spots appear stopped, accurately read the tachometer percent. Use the difference between this reading and 7953 RPM as the tachometer error for full throttle operation.

b. Make an accurate check of the tachometer error at 3030 RPM. When the 36 spots appear stopped, accurately read the tachometer percent. Use the difference between this reading and 3030 RPM as the tachometer error for idle operation.

7–88. OVERSPEED. Under no conditions shall the engine be operated in excess of 8030 (101%) RPM except in momentary overspeeds where 8268 (104%) RPM is absolute maximum.

Note

If engine overspeed above 104 percent to 108 percent is encountered, the turbine wheel must be replaced. For overspeed above 108 percent the engine must be returned to overhaul.

7–89. ENGINE SPEED REQUIREMENTS.

a. Set the main system high speed stop to yield an RPM between 7960 to 8030.

b. The main system idle speed shall be set by throttle manipulation between 3000 + or −100 RPM. The control shaft pointer at Nr 4 island shall coincide with the idle speed mark on the escutcheon plate.

c. Emergency System High Speed. (–27 model.) Set the emergency high speed within the RPM range specified in Figure 7–17.

d. Emergency System Idle Speed—The emergency idle speed shall be within 2800 to 3300 RPM.

7–90. SPEED FLUCTUATIONS. Engine speed fluctuations after stabilization at any point shall not exceed + or −50 RPM.

7–91. ENGINE THRUST FLUCTUATIONS. (This Paragraph is only applicable to engines being given the performance test run.) The maximum acceptable thrust fluctuation is + or −40 pounds.

7–92. AFT FRAME VACUUM PRESSURE. Use Tool Nr 1C1707 to obtain proper pressure (see figure 7–18). The aft frame vent pressure (taken at the pressure tap) must be within the limits of 3 to 9 inches water vacuum at 7953 RPM. If test set 1C1749 is used the pressure within the turbine frame must be within 0 to minus 6 inches H_2O.

7–93. ANTI-ICING PRESSURE. The anti-icing pressure shall be 0 psig before and after actuating the anti-icing valve. While the valve is actuated, the gage pressure must be a positive value.

7–94. EMERGENCY SYSTEM RECOVERY TIME. (–27 model.) The emergency system recovery from a simulated main system failure shall not exceed three seconds.

7–95. ACCELERATION OR THROTTLE BURST TIME. The required acceleration time limit is dependent on compressor inlet temperature. (Refer to Para. 7–121. –23 and –25 models) or Para. 7–119, (–27 model) for special instructions and procedures.

7–96. NUMBER OF STARTS. After a false start or prestart, the next attempted start must not be made until at least 3 minutes have elapsed. Not more than three false starts or prestarts shall be made in succession in any 30 minute period. The 4th attempted start shall not commence until 30 minutes have elapsed from the time of the above stated third unsuccessful start.

7–97. JET NOZZLE AREA LIMITS. The jet nozzle area must be within the 283.5 to 295.6 square inch range. This area limit range is applicable to conical nozzle; therefore, it shall be necessary to convert the variable area to equivalent conical area for comparison.

7–98. MISCELLANEOUS LEAKAGE LIMITS.

7–99. ACCESSORY FUEL LEAKAGE LIMITS. During testing of the engine operating at IDLE speed, the following accessory drain parts shall be inspected for excessive overboard leakage.

a. The maximum acceptable leakage from the flow divider drain port is 55 cc per minute.

b. The maximum acceptable leakage from the emergency regulator drain port is 100 cc per minute. (–27 model).

Note

In cases where excessive leakage into the compressor inlet is noted, the regulator sensing line shall be disconnected from the forward frame sensing line adapter and the combined leakage of the regulator drain and sensing line shall be measured. The combined leakage shall not exceed 100 cc per minute.

c. The maximum acceptable leakage from main fuel pump drain at idle speed is 6 cc per minute.

d. The maximum acceptable leakage from stopcock drain port is 9 cc per minute.

7–100. CROSS IGNITION TUBE LEAKAGE LIMITS. Fuel and/or air leakage noted at the cross ignition tube Marmon camp will be disregarded and will not be cause for engine rejection. Soot originating from Marmon type cross ignition tube will not be cause for engine rejection unless upon completion of the acceptance test schedule the removal of soot reveals metal discoloration which would indicate exposure to extreme temperature of flame leakage from internal combustion.

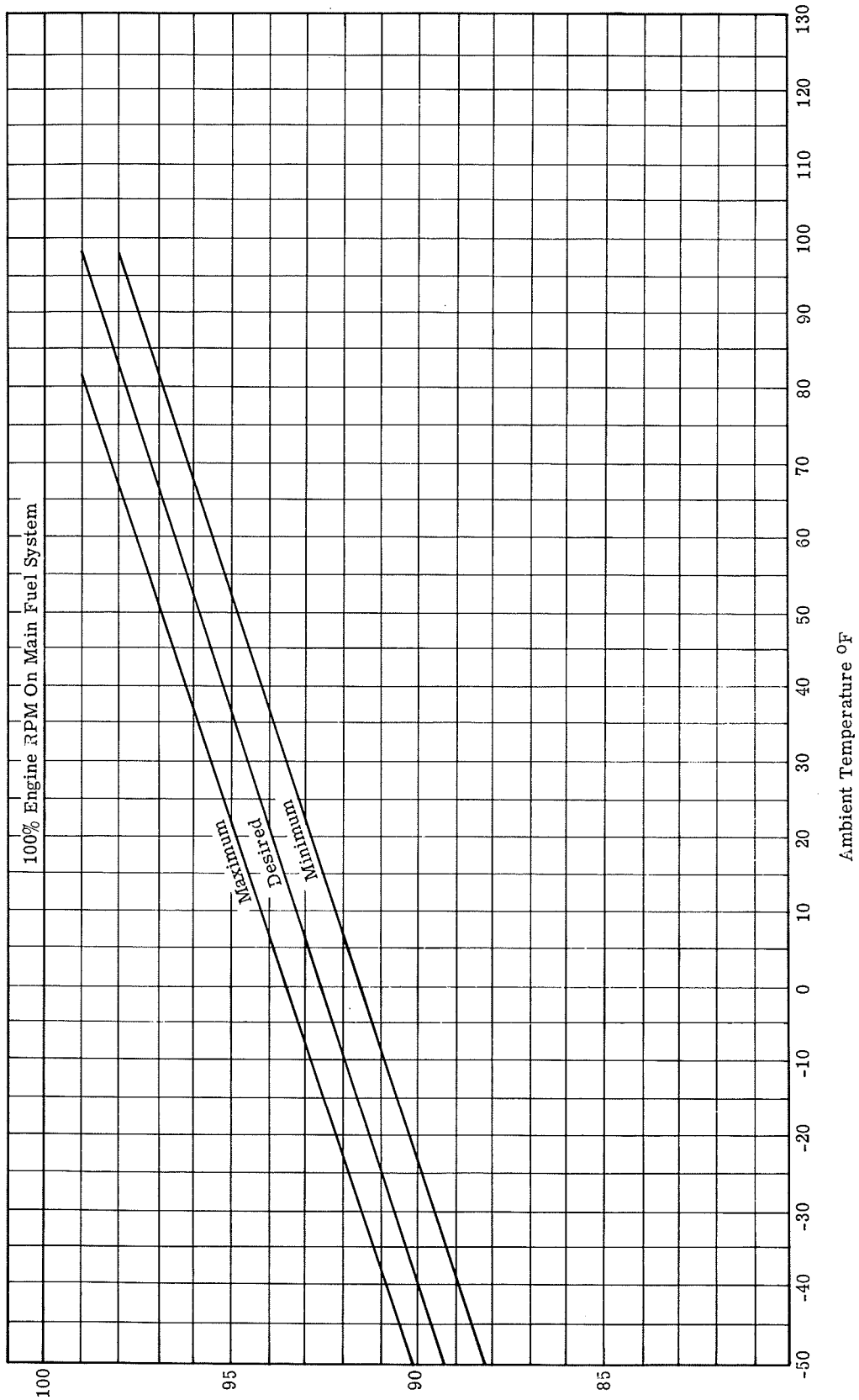


Figure 7-17. Emergency RPM Chart

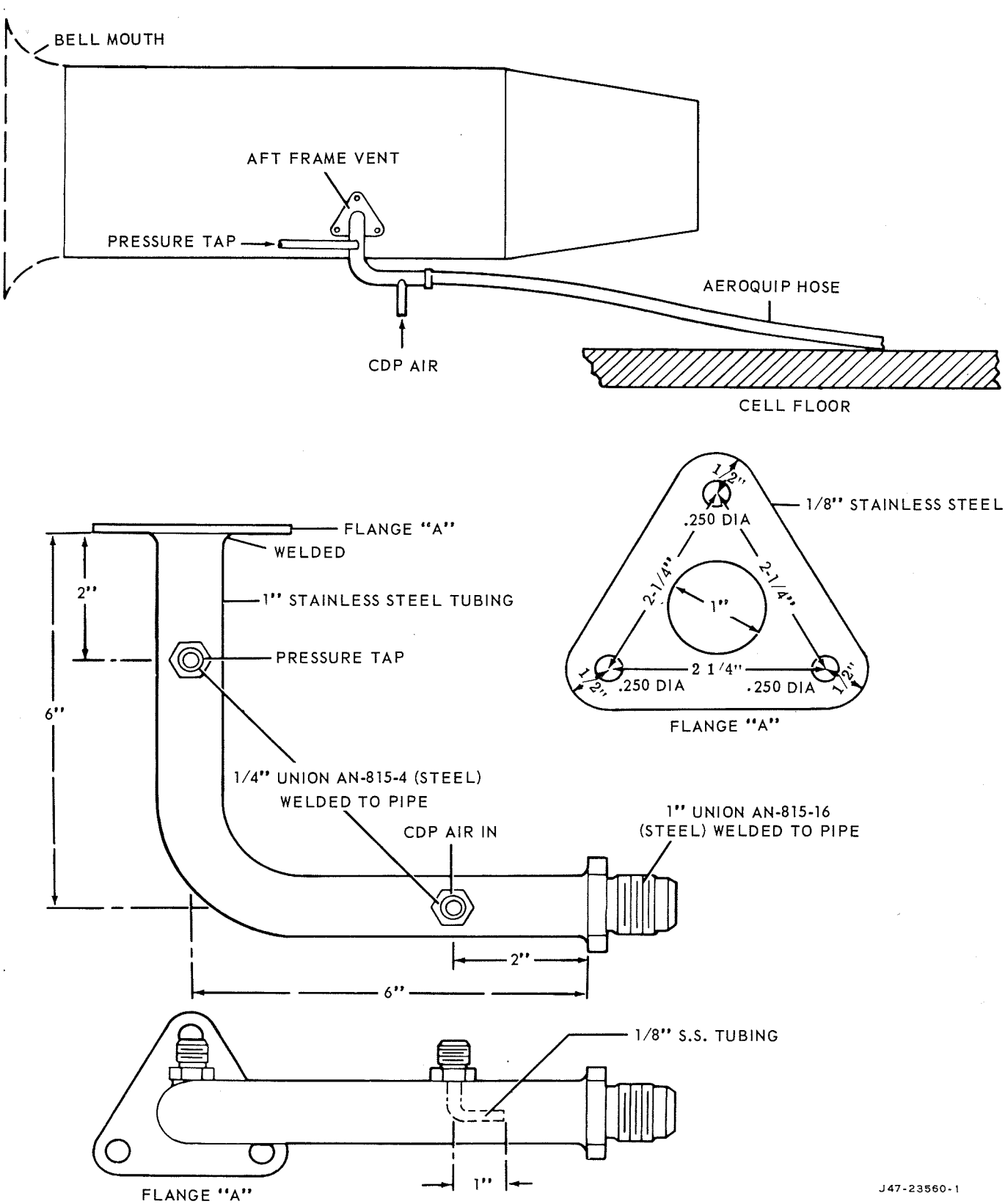


Figure 7-18. Aft Frame Vent Aspirator, 1C1707

7-101. OIL LEAKAGE LIMITS. The following limits apply to pads on the accessory gear case assembly.

a. 2 cc per hour maximum per pad.

b. 5 cc per hour maximum from power take-off housing.

7-102. ENGINE SHUTDOWN PROCEDURE.

7-103. NORMAL SHUTDOWN PROCEDURE. Normal engine shutdown, except where otherwise specified shall be accomplished as follows:

a. With the engine operating on main system, at 60 to 70% RPM for one minute, close throttle rapidly to the STOPCOCK position.

CAUTION

Do not shut engine down by closing the engine fuel supply valve.

b. After engine RPM has dropped to 0, close the engine fuel supply valve and return all applicable panel switches to either OFF or NORMAL engine shutdown positions.

7-104. EMERGENCY SHUTDOWN PROCEDURE. Emergency shutdown may be made from any throttle position by retarding throttle to the STOPCOCK position and immediately turning off the engine fuel supply.

7-105. ENGINE FLAME-OUT SHUTDOWN. If an engine flame-out is experienced during engine operation, the throttle shall be moved immediately to the STOPCOCK position. After rotor stops turning, close the test cell fuel supply valve. Return all applicable panel switches to their OFF or NORMAL position and investigate and correct cause before continuing test.

7-106. FUNCTIONAL RUN.

7-107. GENERAL. All starts and accelerations to, and decelerations from IDLE speed shall be made with the fuel system selector switch in the MAIN position, (-27 model only) and the compressor inlet screens in the closed position unless otherwise specified. Make adjustments and checks as outlined in this paragraph, and in the sequence listed.

7-108. PRESTART ADJUSTMENTS AND CHECKS. Accomplish prestart adjustments and checks as follows:

a. Clear cell of foreign objects, such as loose concrete chips, nuts, bolts, safety wire, etc.

b. Inspect engine intake and exhaust outlet for foreign material.

c. Check fire extinguishers for serviceability and proper position.

d. Check ignition as follows:

(1) Master switch ON.

(2) Ignition switch, IGNITION TEST.

(3) Listen for sparking sound at each ignitor plug position or remove plugs for visual check.

CAUTION

Do not operate ignition system for more than two minutes. Be sure there is no fuel in the engine for the above check.

e. Standardize the temperature indicating potentiometer.

f. Connect test cell fuel supply line to engine fuel pump inlet adapter.

g. Check operation of retractable compressor air inlet screens if applicable.

h. Make preliminary check of vibration meter and circuit. (Refer to applicable Technical order pertaining to equipment being used.)

Note

The foregoing check is not a calibration of the vibration measuring equipment, but is only an operational check to ascertain that the equipment is ready to operate.

WARNING

Serious injury may result if the following safety precautions are not followed throughout the engine test.

1. Keep the danger areas (engine exhaust and inlet) at the test area clear of all personnel and vehicles during engine operation. The danger areas during engine operation are as follows:

   a. The engine exhaust area. Stay outside of the area included within a sixty degree arc extending for 200 feet behind the engine. The temperature and velocity of the jet exhaust are extremely hazardous. (See figure 7-18A.)

   b. The engine inlet area. Stay outside the area included within a 25 foot radius directly in front of the engine inlet. Suction at the air inlet can cause injury by drawing the person into or against the air intake.

   c. Be cautious when approaching the engine from the sides. Do not expose the face or hands to the direct blast of air from discharge vents.

   d. Do not stand at the turbine area at any time when engine is above IDLE operation.

2. Be extremely careful when handling all jet fuels (JP4, JP5, or Av-gas). Observe the following precautions:

   a. All fuel vapors are heavier than air; if they settle and collect in confined areas, they are highly flammable. Permit fumes to disperse and avoid open flames/sparks.

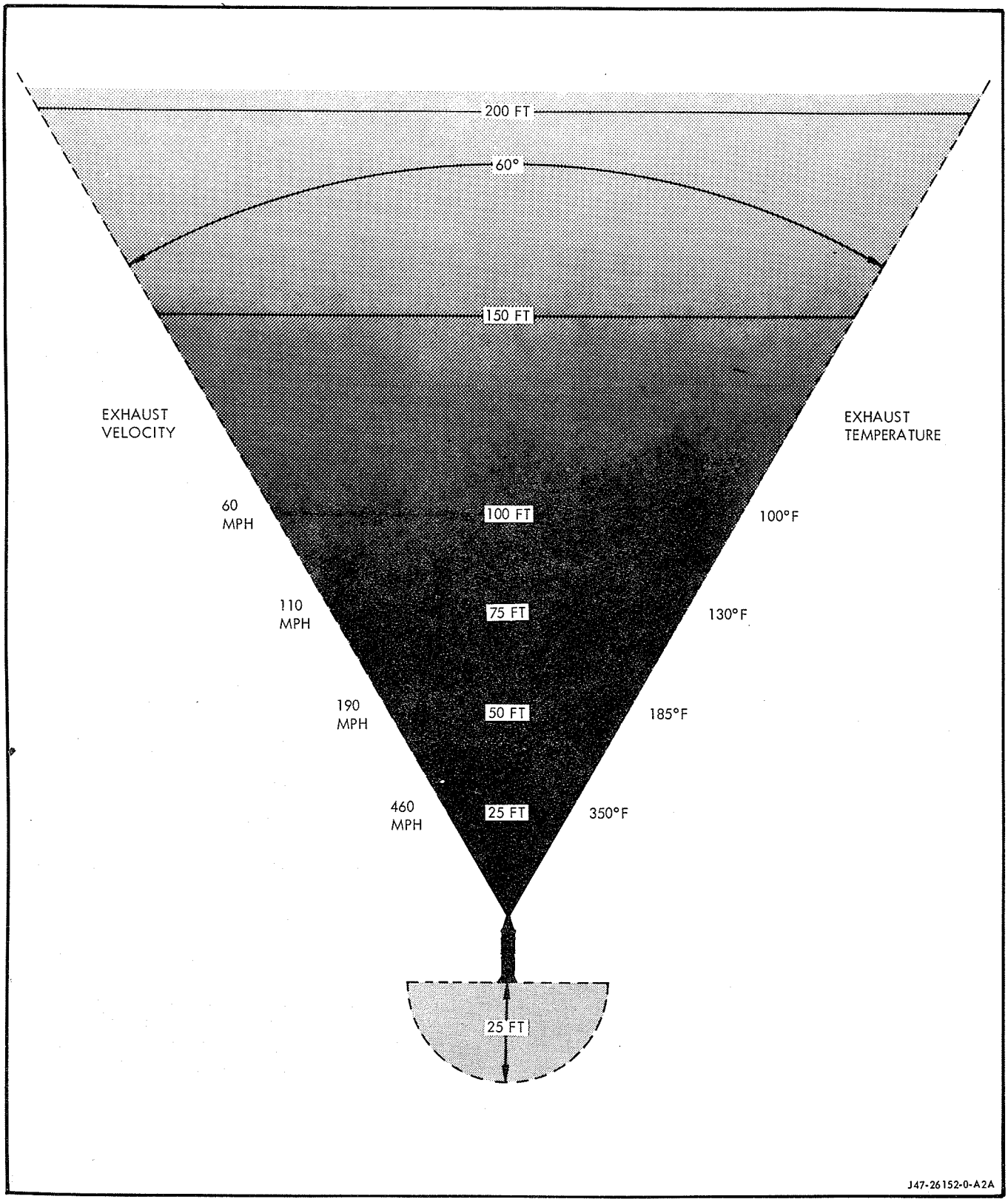


Figure 7-18A. Jet Wake Diagram

b. When the ambient temperature is above 80°F, jet fuels will ignite more readily than low octane gasoline if exposed to a hot object. Avoid contact of hot objects and fuel.

c. Jet fuels will produce an ignitable mixture in air spaces over a wider range of temperature than low octane gasoline. Handle jet fuels with caution at all temperatures.

3. Prolonged breathing of fuel fumes or swallowing of fuel can cause serious illness. The work area must be well ventilated. Jet fuels and lube oils may also be irritating to the skin. Persons splashed or sprayed with jet fuel or lube oil must do the following:

a. Immediately leave the test area.

b. Remove soaked clothing, in an area free from any possible source of ignition, as soon as possible.

c. Thoroughly wash all areas of skin that were in contact with fuel or lube oil.

d. Dry the soaked clothing outdoors and wash clothing in soap and water before wearing again.

7-108A. FUEL REGULATOR PRIMING. The fuel regulator should be primed if the regulator or fuel control valve is changed. To prime the regulator proceed as follows:

a. Connect a clean, filtered supply of regular engine oil to the main fuel regulator priming fitting at the No. 4 island. Pump oil into the regulator under a pressure not exceeding 8 psi. Do not exhaust the oil supply thus allowing air to enter regulator.

CAUTION

Equipment used to prime the regulator must have adequate provisions to insure that only clean oil reaches the regulator. Failure to use clean filtered oil will result in contaminating the regulator and a subsequent fuel system malfunction.

Note

If necessary, slightly loosen the VCO (Variable Control Oil) line at the fuel control valve to remove all trapped air. If the VCO line is loosened, retighten it when the oil flows free of air and while the oil is being pumped under pressure.

b. Disconnect priming equipment and install a pressure cap on the priming fitting on No. 4 island. Torque cap. (Refer to Section VIII, table XLI.)

Note

Some regulators will prime by motoring the engine with the starter-generator. If this procedure is used, the VCO line should be slightly loosened at the fuel control valve to insure that all trapped air is removed. Retighten the VCO line when the oil flows free of air and while the engine is being metered.

7-109. ENGINE PURGING PROCEDURE. Due to variations in test cells, precise engine purging procedures cannot be included in this technical order. In general, the following procedure is common and shall be accomplished after each initial engine installation, or installation of any portion of the engine fuel system, which may have drained the controls or adjacent fuel or oil lines, unless specific instructions pertaining to one installation are issued.

a. Throttle lever, OFF.

b. Engine fuel supply, ON. Ascertain inlet pressure is within specified limits.

c. Engine lube booster pump, ON. (Or if lube tank is elevated, open oil inlet and outlet valves.)

d. Ignition switch, OFF.

e. Start switch, and stopwatch ON.

f. When engine speed reaches approximately 6% RPM, advance throttle lever to the approximate IDLE position until one of the following occurs, then press the EMERGENCY STOP START SWITCH.

(1) Small slot pressure of 15 psig has been obtained. Do not exceed 40 psig.

(2) Maximum of 9% RPM has been obtained.

(3) Maximum of 30 seconds of motoring time has elapsed.

g. Retard throttle lever to the STOPCOCK position.

CAUTION

If fuel flow and/or small slot pressure does not drop to zero, the stopcock is not shutting off the fuel flow and the engine is not safe to start. During the time the throttle is open, raw fuel is being sprayed into the combustion chambers. This fuel should drain from the

combustion chambers within 3 minutes after throttle is closed. Therefore, always wait a minimum of 3 minutes before attempting to operate the engine; otherwise excessive EGT may result, with serious consequence to the engine.

h. During period that engine is being turned over with starter, investigate any unusual noises in engine.

i. Check entire engine carefully for fuel and oil leaks, particularly in the accessory section. Make sure all fuel and oil drains are open and are draining properly.

j. Check fluid level of lube oil tank, refill if necessary with specified type. Make a note of the oil level for consumption purposes, which will be rechecked after completing the FUNCTIONAL TEST when called for in Paragraph 7-126 - h. If a PERFORMANCE TEST is to follow this test disregard.

7-110. ENGINE START. Start engine in accordance with Paragraph 7-111. Record data during starting in accordance with Paragraph 7-112 and 7-113.

7-111. START PROCEDURE. Due to the variations in test cells, precise starting procedure cannot be included in this technical order. In general, the following procedure is common and will be accomplished unless specific procedures pertaining to one installation are issued.

Note

The variable jet nozzle area should be increased as much as practical during the initial START of engine to minimize the possibility of overtemperature. Engine must accelerate from 0 RPM to IDLE speed within 2 minutes without exceeding maximum temperature limits.

a. Throttle lever, STOPCOCKED.

b. Test fuel supply, ON.

c. Lube oil supply, ON.

d. Master switch, ON.

e. De-icing air switch, OFF.

f. Retractable air inlet screen switch, CLOSED position.

g. Fuel system selector switch, MAIN position unless otherwise specified (-27 model engine).

h. Acceleration compressor discharge pressure bleed valve switch BLEED OFF unless otherwise specified (-23 and -25 model only).

i. Fire guard and inspector posted.

j. Ignition switch ON.

k. Starting switch ON. (Stopwatch shall be turned ON simultaneously with the start switch, and turned OFF when engine speed reaches IDLE.)

Note

When start switch is tripped, starter will remain energized until engine speed reaches starter drop-out speed (22 to 28% RPM). If it does not, actuate EMERGENCY STOP START switch.

l. When engine speed reaches approximately 6% (450 to 500 RPM), advance throttle lever to obtain a small slot fuel pressure of 30 to 35 psig. (approximately 15 degrees position on the Nr 4 island control shaft pointer). Observe the EGT indicator, the engine should fire within 5 seconds and automatically attain 13 to 15% speed. After engine fires advance throttle lever slowly to IDLE speed, observing EGT indicator and tachometer throughout start acceleration. Rapid throttle movement may cause overtemperature in this speed range. Do not exceed limits. The starter should dropout automatically.

CAUTION

* As stated above, the engine should fire within 5 seconds after throttle advance at approximately 6% speed; however, if it does not fire before 8 seconds, retard throttle lever to the STOPCOCK position and immediately press the EMERGENCY STOP START switch. This constitutes a false start.

* During the start cycle, the engine speed must reach 22 to 28% RPM (starter drop out speed) within 60 seconds. If too much time is required for engine speed to reach starter drop out speed, the starter and engine combustion chamber or cross ignition tubes can be extensively damaged. The excessive time required is usually the result of insufficient starter electrical power supply.

* If for any reason the starter should become de-energized during an engine start before the engine reaches a speed of approximately 20% RPM, the throttle lever should be closed immediately. No attempt should be made to accelerate without starter assist.

* Do not keep power on starter longer than one minute during any start, as damage to starter may occur from overheating. Operation of the engine starter is limited to three runs of one minute period. There must be at least 3 minutes from the end of one start to the beginning of the next start.

m. During the initial start and acceleration, to IDLE speed make a note of lube oil pressure. If no rise in lube pressure is noted, by the time IDLE speed is reached, increase engine RPM until a definite rise in lube oil pressure is apparent, or until 80% RPM is reached. If no pressure increase is noted when 80% RPM is reached or before 60 seconds, shutdown the engine and investigate the cause and correct before continuing run.

n. Operate engine at stabilized IDLE speed for five minutes. During this initial run period the engine tach-

ometer shall be calibrated in accordance with Paragraph 7-87-b. after completing the prescribed recordings outlined in Paragraph 7-113, and the initial operational inspection revealed satisfactory results, continue with the outlined FUNCTIONAL RUN, in the order given.

7-112. DATA TO BE RECORDED DURING START.

a. Time from starter ON to stabilized IDLE speed.

b. Maximum indicated EGT obtained and duration during start, °F.

c. Speed at which engine fired, percent.

7-113. DATA TO BE RECORDED AT STABILIZED START SPEED (IDLE).

a. Time of day.

b. Duration of run, minutes.

c. Observed RPM (corrected for tachometer error).

d. Vibration, mils displacement.

e. Lube oil pressure, psig.

f. Small slot fuel pressure, psig.

g. Fuel supply inlet pressure, psig.

h. Compressor inlet temperature, °F.

i. Oil inlet temperature, °F.

j. Oil outlet temperature, °F.

k. Thrust, lbs. (corrected for calibration error).

l. Exhaust gas temperature, °F.

m. Exhaust gas temperature spread, °F.

7-114. TAKE-OFF TOP SPEED CHECK, MAIN SYSTEM.

a. With engine operating at idle speed, advance throttle slowly, checking vibration, to 7953 RPM. Do not exceed maximum allowed steady state EGT 690°C (1275°F). It may be necessary to adjust the variable jet nozzle. Adjust nozzle to yield maximum allowed EGT, or as close as possible. Calibrate tachometer. (Refer to Paragraph 7-87).

b. Advance throttle lever slowly until one of the following occurs:

(1) Full throttle is reached before 7960 RPM is reached. This would indicate the high speed stop is set too low.

(2) 8030 RPM is reached before full throttle is reached. This would indicate high speed stop is set too high.

CAUTION

Do not operate engine in excess of 8100 RPM (102%) (Refer to Paragraph 7-88) CDP bleed valve must be OFF when setting high speed stop and EGT.

7-115. TAKE-OFF TOP SPEED ADJUSTMENT.

a. Adjust the high speed stop screw, on Nr 4 island, until full throttle speed is between 7960 and 8030 RPM (100.1 - 101%).

Note

One turn of the high speed stop screw is equivalent to approximately 75 RPM. There should be at least 5 turns on the head end and 2 turns on the tip end remaining on the high speed stop screw after final adjustment.

b. Record the engine maximum stabilized speed.

Note

During operation at 100%, note and use the compressor inlet temperature in selecting the desired emergency top speed to be set in the next step.

7-116. EMERGENCY TOP SPEED CHECK AND ADJUSTMENT (-27 MODEL).

a. With engine operating at 7000 RPM (88%) on main fuel system, switch fuel system selector switch to EMERGENCY CHECK. Advance the throttle slowly until one of the following occurs.

(1) Full throttle is reached before desired emergency top speed is obtained. (See Figure 7-17). This would indicate emergency top speed is set too low.

(2) Emergency maximum speed is obtained before full throttle is reached. This would indicate that emergency stop speed is set too high.

b. If emergency top speed is not within limits specified in chart (Figure 7-17) adjust the speed as follows:

(1) Adjust the emergency control linkage, while engine is operating at idle speed, to obtain desired speed + or — 1%.

Note

Lengthening the emergency control linkage one complete revolution decreases the speed approximately 150 RPM.

(2) After final adjustments have been made, check inspection holes on each end of emergency control linkage. Control rod threads shall be visible or linkage readjusted.

Note

If proper RPM cannot be obtained by control rod adjustment, the emergency fuel regulator may be defective.

7-117. EMERGENCY CONTROL RECOVERY CHECK.

a. With the engine operating on main system at full throttle, place fuel system selector switch from MAIN to EMERGENCY (at the same instant, start the stopwatch) and observe small slot fuel pressure. The instant the small slot fuel pressure starts to increase, stop the stopwatch. This is recovery time and shall not exceed 3 seconds.

Note

This timing cycle is necessary only when RPM of the engine falls below emergency RPM limits. If the RPM does not fall below emergency RPM limits, the emergency fuel regulator is performing satisfactorily.

(1) If the recovery time of the emergency control

exceeds 3 seconds, replace the bleed plug with one of the next higher part number, small diameter, in the emergency fuel regulator and recheck the recovery time. Follow this procedure until recovery time is within the 3 seconds limit. There are six sizes of bleed plugs supplied at the present time. (Refer to Table XXXIIIB). They are identified by the part number marked on the head of the plug.

TABLE XXXIII B. BLEED PLUGS

Part Number	Plug Diameter
8734-1	0.1579 - 0.1581
8734-2	0.1569 - 0.1571
8734-3	0.1564 - 0.1566
8734-4	0.1559 - 0.1561
8734-5	0.1554 - 0.1556
8734-6	0.1549 - 0.1551

Note

When replacing a bleed plug, use a new O-ring seal.

CAUTION

Do not attempt the absolute minimum recovery time because unstable operation of the emergency fuel regulator, as evidenced by a violent fluctuation in fuel pressure and/or fuel flow may occur. If unstable operation occurs, use a lower part number, larger diameter, bleed plug. If this does not provide satisfactory recovery time and stable operation, replace the emergency fuel regulator.

(2) Check repeatability by operating engine at full throttle on MAIN system. Throw fuel selector switch from MAIN to EMERGENCY 3 times. Speeds on emergency system should repeat within 60 RPM, speeds on main system should fall within 7960 to 8030 RPM limits. Each recovery time must be within the 3 seconds limit.

b. Data to be recorded during emergency system operational check.

(1) Compressor inlet temperature, °F.

(2) Emergency maximum RPM.

(3) Recovery time, seconds.

7-118. EMERGENCY IDLE CHECK AND ADJUSTMENT (-27 MODEL). With the engine operating on MAIN system at idle speed (3030 RPM), check emergency idle speed as follows:

a. Switch fuel system selector switch to EMERGENCY. If engine tends to overspeed, retard throttle. If engine tends to die, advance throttle.

(1) Emergency idle speed shall be 2800 to 3300 RPM.

Note

If RPM during the emergency idle check is not within specified limits, advance or retard the throttle as necessary to obtain desired speed. If emergency idle speed cannot be set within specified limits by throttle manipulation, make the following adjustments in lieu of replacing emergency fuel regulator.

b. Emergency idle speed adjustment.

(1) Mark with a pencil the relative position of clamp and clevis with EC-2 manual control shaft.

(2) Loosen clamp and clevis on EC-2 manual control shaft. Turn clamp and clevis one spline clockwise to lower RPM or one spline counter-clockwise to increase RPM.

Note

Do not move clamp and clevis more than one spline per adjustment. Two splines are the maximum number of splines that clamp and clevis may be moved.

(3) If clamp and clevis were moved clockwise, shorten emergency linkage 4 and ½ rounds. If clamp and clevis were moved counterclockwise lengthen emergency linkage 4 and one-half rounds before rechecking high speed emergency.

7-119. ACCELERATION TIMING AND ADJUSTMENTS (-27 MODEL).

a. Accomplish the following before attempting acceleration check.

(1) Anti-icing system OFF.

(2) Take-off stop set correctly.

(3) Exhaust gas temperature within limits.

(4) Fuel system selector switch on MAIN system.

b. Operate engine at 100% RPM for one minute to allow for temperature stabilization.

Note

A minimum operation time of eight minutes at 100% RPM must elapse after starting a cold engine before the engine temperatures are stabilized.

c. Decelerate to 3180 RPM (40%) and allow speed to stabilize.

d. Advance throttle rapidly to full open and start stopwatch simultaneously.

CAUTION

Observe transient exhaust gas temperature closely. If EGT exceeds maximum limits or engine stalls, retard throttle to IDLE position immediately.

e. Observe the small slot fuel pressure; when it reduces sharply just before engine reaches maximum

speed, stop the stopwatch. The elapsed time shown on the stopwatch is the measured acceleration time and must not exceed the values as shown in figure 7-18B.

7-120. ACCELERATION ADJUSTMENTS. Check acceleration time, and adjust if necessary, after replacement of flow divider, fuel control valve, main fuel regulator and all testing after minor repair.

TABLE XXXIIIC. (Deleted)

a. Flow divider adjustment for engine stall condition (Refer to Figure 7-19).

Note

The J47-27 model configuration does not include the CDP bleed and trimmer valve fuel components; therefore, acceleration rates and stalls will be corrected by flow divider adjustment.

(1) Remove bleed plug, loosen locknut, and adjust rod and piston two turns clockwise before making an-

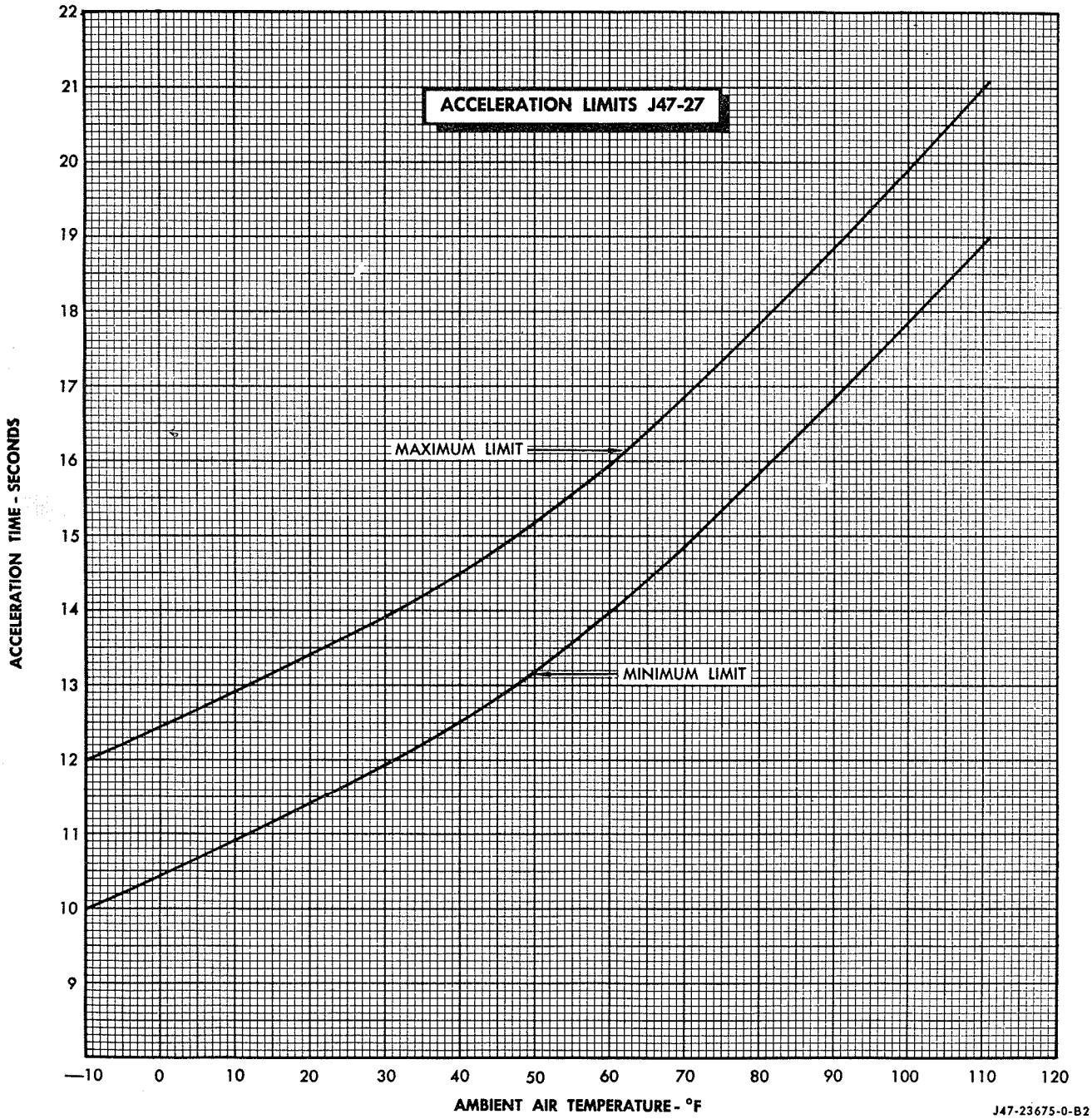
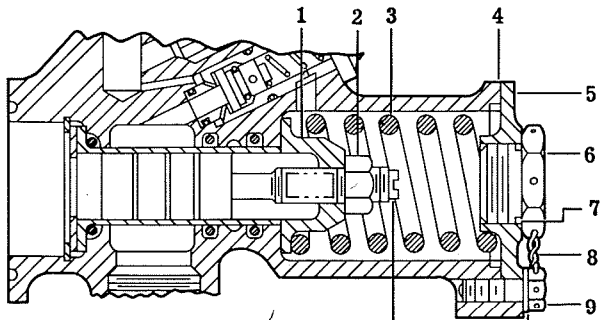


Figure 7-18B. Acceleration Limits J47-27

other acceleration. If stall occurs again, make an additional adjustment one turn clockwise.

(2) If transient exhaust gas temperature is exceeded during throttle burst, decelerate immediately. Adjust rod and piston one turn clockwise before making another acceleration check.

b. Flow divider adjustment for slow acceleration time.



1. Stop
2. Locknut
3. Spring
4. Gasket
5. Cover
6. Plug and Bleeder
7. Gasket
8. Lockwire
9. Bolt
10. Washer
11. Rod and Piston

Figure 7–19. Flow Divider Schematic

Note

A one-fourth turn of the rod and piston will change acceleration time approximately one second. A clockwise adjustment increases acceleration time and a counterclockwise adjustment decreases acceleration time.

(1) Check compressor discharge pressure sensing line to main fuel regulator for air leaks.

(2) Remove bleed plug, loosen locknut and adjust rod and piston as necessary to obtain desired acceleration time.

(3) Torque locknut 13 to 16 inch-pounds; torque bleed plug 75 to 100 inch-pounds.

7–121. ACCELERATION CHECKS AND ADJUSTMENTS (–23, –25 and –25A MODEL ENGINES).

7–122. ACCELERATION CHECKS (CDP OFF).

a. Accomplish the following before starting acceleration checks.

(1) Anti-icing system OFF.

(2) High speed stop set correctly (CDP valve OFF).

(3) Open the CDP bleed valve (turn counterclockwise) 2 and 1/2 turns from full closed.

(4) Open acceleration trimmer valve (turn counterclockwise) two turns from full closed.

CAUTION

If inlet air temperature is above 60°F, checks and adjustments for both CDP bleed ON and OFF must be complied with. Only the average measured bleed OFF time will be recorded. If the inlet air temperature is 60°F or below, the acceleration time must be checked and adjusted with CDP bleed ON; in addition an attempt will be made to check and adjust CDP bleed OFF acceleration time. If a satisfactory adjustment cannot be obtained for a CDP bleed OFF acceleration at inlet air temperatures below 60°F, repeat the acceleration check and adjustment on a warmer day.

b. Operate engine at 100% RPM for one minute. (Eight minutes must elapse after starting a cold engine before engine temperature stabilizes.)

c. Decelerate engine speed to 40% RPM and stabilize for one minute.

d. Advance throttle rapidly to full open position and start stopwatch simultaneously.

CAUTION

Observe transient exhaust gas temperature closely. If temperature exceeds maximum limits or engine stalls, immediately retard throttle to idle position.

e. Observe small slot fuel pressure; when it reduces sharply just before engine speed reaches governed speed, stop the stopwatch. The elapsed time shown on the stopwatch is the measured bleed OFF acceleration time.

f. Repeat throttle bursts until the acceleration time of two consecutive throttle bursts agree within one second. Use the average time of the two bursts as "measured acceleration time".

g. Use the CIT and measured acceleration time with CDP OFF and refer to Table XXXIII D to determine the need for trimmer valve adjustment.

Note

Trimmer valve adjustment may be made while engine is operating at idle speed. No adjustment will be made for acceleration or stall malfunction on flow divider unless absolutely neccessary as they have been prescheduled before installation. All adjustments for accelerations will be accomplished by use of CDP bleed and/or trimmer valve, if possible.

7-123. ACCELERATION TRIMMER VALVE ADJUSTMENT.

a. A one-fourth turn of the acceleration trimmer valve adjusting screw changes acceleration time by approximately one-half second.

b. To decrease the acceleration time turn the acceleration trimmer valve adjusting screw counterclockwise.

c. To increase acceleration time turn the acceleration trimmer valve adjusting screw clockwise.

d. If stalls occur or EGT limits are exceeded adjust the acceleration trimmer valve adjusting screw clockwise.

e. If the measured bleed OFF acceleration exceeds the standard acceleration limit (Table XXXIII D), adjust the acceleration trimmer valve counterclockwise.

f. When measured acceleration CDP bleed OFF time is set within limits, proceed with CDP bleed ON checks and adjustments.

Note

To ensure proper balance between flow divider and trimmer valve and also adequate flight idle speed at high altitudes, the trimmer valve should be from one to 3 turns open after final adjustments are completed. If it is not, the flow divider should be readjusted so that trimmer valve is one to 3 turns open.

7-124. ACCELERATION CHECKS (CDP ON).

a. Operate engine at 100% RPM for one minute. (CDP ON).

TABLE XXXIII D. STANDARD ACCELERATION TIME — J47-23, -25, AND -25A ENGINES

(MAIN FUEL REGULATORS P/N'S 14250-B1, 14250-B2 AND 14250-C2)

Ambient Air Temperature		Acceleration Time (seconds)				Ambient Air Temperature		Acceleration Time (seconds)			
		Bleed ON		Bleed OFF				Bleed ON		Bleed OFF	
°C	°F	Max	Min	Max	Min	°C	°F	Max	Min	Max	Min
-51	-60	9.7	8.4			9	48	17.6	15.1	13.4	11.3
-46	-50	9.9	8.6			10	50	18.0	15.3	13.6	11.5
-40	-40	10.2	9.0			11	52	18.4	15.6	13.8	11.6
-38	-36	10.3	9.1			12	54	18.8	15.9	14.0	11.8
-36	-32	10.4	9.2			13	56	19.2	16.2	14.2	12.0
-33	-28	10.5	9.3			14	58	19.6	16.5	14.4	12.1
-31	-24	10.7	9.5			16	60	20.1	16.8	14.6	12.3
-29	-20	10.8	9.6			17	62	20.6	17.1	14.8	12.5
-27	-16	10.9	9.8			18	64	21.0	17.4	15.0	12.7
-26	-14	11.0	9.9			20	68	22.0	18.0	15.5	13.1
-24	-12	11.1	10.0			21	70	22.5	18.3	15.7	13.3
-22	- 8	11.3	10.1			22	72	23.1	18.6	16.0	13.5
-20	- 4	11.5	10.3			23	74	23.6	19.0	16.2	13.7
-18	0	11.7	10.5	10.0	8.3	24	76	24.1	19.3	16.5	14.0
-17	2	11.8	10.6	10.1	8.4	26	78	24.6	19.6	16.8	14.2
-16	4	11.9	10.7	10.2	8.5	27	80	25.2	20.0	17.0	14.5
-14	6	12.0	10.8	10.3	8.6	28	82	25.7	20.3	17.3	14.7
-13	8	12.2	10.9	10.4	8.7	29	84	26.3	20.6	17.6	15.0
-12	10	12.4	11.1	10.5	8.9	30	86	26.8	21.0	17.9	15.3
-11	12	12.5	11.2	10.6	9.0	31	88	27.4	21.4	18.2	15.5
-10	14	12.7	11.3	10.8	9.1	32	90	27.9	21.7	18.5	15.8
- 9	16	12.9	11.5	10.9	9.2	33	92	28.5	22.1	18.8	16.1
- 8	18	13.1	11.7	11.0	9.3	34	94	29.0	22.4	19.1	16.4
- 7	20	13.3	11.8	11.2	9.4	36	96	29.6	22.8	19.4	16.7
- 6	22	13.5	12.0	11.3	9.6	37	98	30.2	23.2	19.8	17.0
- 4	24	13.7	12.2	11.5	9.7	38	100	30.7	23.6	20.1	17.3
- 3	26	14.0	12.4	11.6	9.8	39	102	31.2	23.9	20.4	17.6
- 2	28	14.2	12.6	11.8	9.9	40	104	31.7	24.3	20.8	17.9
- 1	30	14.5	12.9	11.9	10.1	41	106	32.4	24.6	21.1	18.3
0	32	14.8	13.1	12.1	10.2	42	108	32.9	25.0	21.5	18.6
1	34	15.1	13.3	12.2	10.3	43	110	33.3	25.4	21.8	19.0
2	36	15.4	13.5	12.4	10.5	44	112	33.8	25.8	22.2	19.4
3	38	15.7	13.8	12.6	10.6	46	114	34.4	26.2	22.6	19.7
4	40	16.1	14.0	12.7	10.7	47	116	34.9	26.5	23.0	20.1
6	42	16.4	14.3	12.9	10.9	48	118	35.3	26.9	23.4	20.5
7	44	16.8	14.5	13.1	11.0	49	120	35.8	27.2	23.8	20.9
8	46	17.2	14.8	13.2	11.2						

Note

Engine RPM may be less than 100% RPM with CDP ON. Do not readjust high speed stop.

b. Decelerate engine speed to 40% RPM and stabilize for one minute.

c. Advance throttle rapidly to full open position and start stopwatch simultaneously.

CAUTION

Observe transient exhaust gas temperature closely. If temperature exceeds maximum limits or engine stalls, immediately retard throttle to idle position.

d. Observe small slot fuel pressure; when it decreases sharply just before engine speed reaches governed speed, stop the stopwatch. The elapsed time shown on the stopwatch is the measured bleed ON acceleration time.

e. Repeat throttle bursts until the acceleration time of two consecutive throttle bursts agree within one second. Use the average time of the two bursts as "measured bleed ON acceleration time".

f. Use the CIT and measured bleed ON acceleration time and refer to Table XXXIIID to determine the need for CDP bleed valve adjustment.

Note

CDP bleed valve adjustment may be made with engine operating at idle speed.

7-125. CDP BLEED VALVE ADJUSTMENT. A one-fourth turn of the CDP bleed valve changes acceleration time approximately one second.

a. To decrease the acceleration time, turn the adjusting screw clockwise.

b. To increase the acceleration time, turn the adjusting screw counterclockwise.

c. If it is not possible to set CDP bleed ON acceleration time within specified limits by use of the CDP bleed valve, adjust the trimmer valve. (Refer to Paragraph 7-121 and 7-122).

Note

The CDP bleed valve must be at least one turn from full closed after adjustments are completed.

d. If acceleration trimmer valve was readjusted recheck bleed OFF acceleration time to ascertain it is within specified limits.

e. When both CDP bleed OFF and CDP bleed ON acceleration time is within specified limits the acceleration time adjustments are complete.

f. Use of CDP bleed test cell control switch (after completing adjustments).

(1) At inlet air temperature of 60°F and below, the CDP bleed switch shall be ON.

(2) At inlet air temperature above 60°F, the CDP bleed switch shall be OFF.

(3) The CDP bleed switch shall be OFF when; setting high speed stop, stabilization run for setting exhaust gas temperature, and performance checks.

7-126. FINAL CHECK OF FUNCTIONAL RUN.

a. Stabilize engine speed at 7953 RPM, 36 slots stopped.

Note

CDP bleed test cell control switch OFF and screens RETRACTED (OPEN) for this check.

b. Check EGT and ascertain it is within limits. Adjust variable nozzle if necessary.

c. After obtaining correct nozzle setting, close screens and reduce engine speed to idle (3030 RPM). Recheck vibration during this slow deceleration.

d. Inspect the engine at this time for any operational leaks and unusual noises. Check the control shaft pointer; it must coincide with the idle mark on the escutcheon plate. Adjust plate if necessary.

e. After completing operational inspection, engine is ready for "shut-down". (Refer to Paragraph 7-102). During this shut-down, obtain rotor coast-down time as follows:

(1) Turn on stop watch and close throttle simultaneously; when rotor stops rotating, turn OFF stopwatch. The elapsed time shown on the stopwatch is the rotor coast-down time. Record this time on test log sheet.

f. Inspect control linkage for full travel and proper operation. Inspect engine for evidence of oil and fuel leaks, hot spots, compressor and turbine rotor damage and security of test equipment and service connections, if performance test is to be given. Re-inspect test cell floor for loose concrete chips, nuts, bolts, safety wire, or any foreign material. Check variable nozzle area; ascertain that its area is within the prescribed limits.

g. Return all switches to their OFF or normal position.

h. Check the fluid level of lube tank. Refill tank to the same level as was done in Paragraph 7-109 - j by measuring amount of oil required to return oil level to the initial start level. Compute oil consumption in pint per hour, or pounds per hour and record results on test log sheet. Refer to Paragraph 7-84 for consumption limit.

i. After completing the FUNCTIONAL TEST and engine has demonstrated its serviceability up to this point, it shall be given the PERFORMANCE TEST, if required by Paragraph 7-11. Proceed with Paragraph 7-126, (-27 model engines) after complying with the following steps. If engine does not require a PERFORMANCE TEST, proceed with Paragraph 7-127 which will complete the required test.

Note

Engines which require a PERFORMANCE TEST, and have not successfully completed the FUNCTIONAL TEST, or are in need of repair or adjustment must not be given the PERFORMANCE TEST until such items are corrected.

j. After completing the checks in Step f. above, install the slave bulletnose fairing and bellmouth (if not previously installed) in preparation of the PERFORMANCE TEST. Inspect engine intake area for foreign objects. Remove them if present.

CAUTION

Be sure fuel supply tank contains sufficient fuel to complete the test run before restarting engine.

7-127. EMERGENCY START PROCEDURE. (-27 MODEL ENGINES). Each -27 model engine must demonstrate one successful emergency start to be acceptable. Due to variation in test cells; precise emergency starting procedures cannot be included in this technical order. In general, the following procedure is common and will be followed unless specific procedures pertaining to one installation are issued. Perform the emergency start as follows:

a. Throttle lever, stopcock position.

b. Engine cell fuel supply ON.

c. Lube oil supply ON.

d. Master switch ON.

e. Emergency fuel selector switch, EMERGENCY position.

f. De-icing air switch, OFF.

g. Retractable air inlet screen switch, CLOSED position.

h. Fire guard and inspector posted.

i. Turn starting switch and stopwatch ON simultaneously.

j. When the tachometer indicates approximately 2.5% RPM, turn ignition switch ON.

CAUTION

It is imperative that the ignition switch be placed in the On position prior to advancing the throttle. Otherwise an explosion followed by fire will very likely occur.

k. When engine speed reaches approximately 6%, advance throttle lever to obtain a small slot pressure of approximately 40 psig. (Approximately 15 degrees position on the Nr 4 island control shaft pointer). When engine fires manipulate throttle to maintain EGT within limits. Rapid throttle movement can cause overtemperature in the starting speed range. Observe the starting cautions outlined in Paragraph 7-111 - l.

l. If engine is to be given the PERFORMANCE TEST, comply with the following, and disregard Step m. below.

(1) After reaching IDLE speed and personnel are out of the cell area, advance throttle lever slowly to approximately 70% RPM, switch emergency fuel selector switch to MAIN position. Stabilize the engine at idle speed. Start the stopwatch timer and put the engine on the PERFORMANCE TEST schedule, Table XXXIIIE.

m. After the engine has demonstrated a successful emergency start, it has completed the FUNCTIONAL TEST. Shut engine down in accordance with Paragraph 7-103. Check the AFTO Form 42 for completeness. If corrosion treatment is necessary, Refer to Technical Order 2J-1-18 for detailed instructions. Return engine to maintenance shop for disposition.

7-128. PERFORMANCE TEST.

Note

Refer to Paragraph 7-7, -9, and -11 which defines the PERFORMANCE TEST.

7-129. PERFORMANCE TEST SCHEDULE. Table

TABLE XXXIII E. PERFORMANCE TEST SCHEDULE

Setting Nr	Run Time Minutes	Speed RPM	% RPM Approx.	Nr of Disc Slots	Record	Note Reference
1	5	3030	38.1	36	3rd	A
2	10	7953	100	36	8th	A-B-C
3	TWO ACCELERATION CHECKS					D
4	2	MAX. EMERGENCY			1st	E
5	2	3030	38.1	36	1st	F
6	SHUTDOWN IN ACCORDANCE WITH PARAGRAPH 7-103					G-H

XXXIIIE gives the performance test requirements. If a shutdown is required, the setting in which the shutdown occurred shall be run again. The performance test is approximately 20 minutes duration. Record data as called for during each setting.

— NOTE REFERENCE —

A. Record the following data. Items 18 through 23 apply to Setting Nr 2 only.
   1. Time of day.
   2. Observed speed, (corrected for tachometer error).
   3. Fluctuation, RPM.
   4. Observed thrust, (corrected for calibration error) lbs.
   5. Thrust oscillations, lbs.
   6. Fuel inlet pressure, psig.
   7. Fuel manifold pressure, psig.
   8. Lube oil pressure, psig.
   9. Lube oil inlet temperature, °F.
   10. Lube oil outlet temperature, °F.
   11. Compressor vibration, mils.
   12. Turbine vibration, mils.
   13. Exhaust gas temperature, °F.
   14. Exhaust gas temperature spread, °F.
   15. Exhaust gas temperature average, °F.
   16. Compressor inlet temperature, °F.
   17. Compressor inlet pressure "Hg, (if desired).
   18. Wet and dry bulb temperature, °F.
   19. Vapor pressure, "Hg.
   20. True barometric pressure, "Hg.
   21. Minimum allowable thrust, lbs.
   22. Thrust variation from minimum allowable, lbs.
   23. Actual sea level equivalent thrust, lbs.

B. Compute engine performance in accordance with instructions. Screens must be in the OPEN (unscreened or retracted) position.

C. Actuate the anti-icing valve three times and record the anti-icing pressure.

D. When accelerating the J47-27 engine the emergency fuel selector switch must be in the MAIN position.

E. Applicable to the J47-27 engine only.

F. Perform visual inspection for fuel, oil, and air leaks.

G. Listen for unusual noises during coast-down. Visually inspect compressor and turbine rotor for damage. If the engine has successfully met the performance test requirements, proceed with the corrosion treatment, if necessary. (Refer to Technical Order 2J-1-18 for details). Return engine to maintenance shop for disposition.

H. Miscellaneous data to be recorded.
   1. Time engine was operated over maximum temperature limits, seconds, and temperature, °F.
   2. Reason for any unscheduled engine shut-down.
   3. Reason for any check or penalty run.
   4. Engine accepted or rejected. If rejected, enter detailed reason in remarks section of test log sheet.
   5. Fill out all applicable spaces on test log sheet.

7-130. ENGINE SYSTEM MALFUNCTIONS.

7-131. GENERAL.

a. Engine malfunctions are of two general types: the very obvious and those not so obvious which, if not detected immediately may cause serious and extensive damage to the engine. To thoroughly and effectively recognize and diagnose engine malfunctions, test operating personnel must have a thorough knowledge of normal engine operation and test limits such as exhaust gas temperature, fuel pressures, oil pressure and vibration. In addition test operating personnel should have a general knowledge of the operation of the various engine accessories, correct routing of fuel, oil, and air lines, and the test cell electrical, air and hydraulic systems.

b. When a malfunction occurs, use a systematic diagnosis. Start with the most probable cause for the trouble and check each possibility in turn; by process of elimination the trouble will be isolated. Systematic diagnosis will save cell time and promote accuracy. The mechanic should never jump to conclusions.

c. Listed in the following paragraph are malfunctions which may cause the engine condition indicated. These malfunctions have been observed on engines undergoing test and are based on practical experience. However, the listed malfunctions are not the only ones which may cause the condition listed. The list of malfunctions is helpful in that it points out many types of faults, which can cause certain kinds of abnormal engine operation.

7-132. TROUBLE SHOOTING DATA.

7-133. PROBABLE CAUSES AND REMEDIES.

7-134. STARTER FAILS TO ROTATE ENGINE DURING STARTING ATTEMPT.

a. Master switch OFF or defective. Turn ON or replace.

b. Starter switch OFF or defective. Turn ON or replace.

c. Starter leads crossed. Check leads.

d. Locked turbine or compressor rotor. Check for free rotations.

e. Defective starter. Replace starter.

7-135. LOW OR INSUFFICIENT CRANKING RPM.

a. Turbine rotor blades rubbing shroud ring. Listen for scraping noise.

b. Low external power supply. Check external power supply.

c. Defective starter. Replace starter.

7-136. SUFFICIENT CRANKING RPM BUT, ENGINE FAILS TO START.

a. Cell fuel supply valve OFF. Turn ON.

b. Defective ignition units. Check igniter plugs. If plugs are not firing, check external power supply and complete ignition circuit. Replace any defective parts.

c. Drip valves stuck open. Replace flow divider.

7-137. ENGINE STARTS, BUT WILL NOT ACCELERATE TO IDLE SPEED.

a. Main fuel regulator, not primed. Prime regulator until oil runs from return line.

b. VCO lines crossed at fuel control valve. Check lines for proper routing. Re-route if necessary.

c. Main fuel pump drive shaft sheared. Replace fuel pump.

7-138. ENGINE WILL NOT ACCELERATE ABOVE APPROXIMATELY 55 TO 65 PERCENT.

a. Air leak in twelfth stage sensing line to main fuel regulator, and/or restrictions. Check line and fittings for leaks. Check for restrictions and clogged fittings.

b. Defective flow divider. Replace flow divider.

7-139. ENGINE WILL NOT REACH 100 PERCENT, BUT WILL RUN ABOVE 65 PERCENT.

a. High speed stop set too low. Adjust high speed stop.

b. CDP bleed switch ON. (-23 and -25 models). Turn CDP bleed switch OFF.

c. Emergency linkage improperly adjusted, prohibiting full travel of main system. Reset linkage (-27 model).

d. Leak in twelfth stage air line to main fuel regulator. Check for leaks, torque fittings.

e. Main fuel regulator linkage improperly adjusted. Adjust governor linkage.

f. Defective main fuel regulator. Replace main fuel regulator.

7-140. ENGINE RPM SURGES OR HUNTS WITH FIXED THROTTLE SETTING.

a. If surging occurs on main system only:

(1) Main fuel regulator malfunction. Prime regulator, replace if surging persists.

b. If surging occurs on emergency system only (-27 model):

(1) Incorrect size bleed plug in emergency control. Install larger diameter bleed plug.

(2) Defective emergency fuel control. Replace emergency control.

c. If surging occurs on both systems:

(1) Unstable fuel supply pressure. Check fuel inlet pressure.

(2) Defective fuel flow divider. Replace flow divider.

7-141. FUEL MIXING WITH LUBRICATING OIL.

a. Internal leak in oil cooler (heat exchanger). Replace heat exchanger.

b. Ruptured diaphragm in fuel control valve. Check by disconnecting hydraulic return line at fuel control valve and turn ON fuel supply valve. If fuel emerges from return port of fuel control valve, the diaphragm is ruptured and must be replaced.

Note

Contamination of lube oil with fuel requires that the main fuel regulator be replaced. Fuel causes deterioration of the main fuel regulator O-rings.

7-142. LOW OR NO LUBRICATING OIL PRESSURE.

a. If tachometer indicator indicates zero RPM with engine running, the main lube and scavenge pump drive shaft is sheared. Replace lube and scavenge pump.

b. Air lock in lubrication line. Disconnect line at Nr 3 island and motor engine to approximately 8 percent. When air lock has been eliminated, reconnect line.

c. Faulty oil pressure gage. Calibrate gage. If necessary, replace gage.

d. Insufficient or no oil to engine oil inlet. Check oil supply. Check boost pump, when applicable.

7-143. HIGH LUBRICATING OIL PRESSURE.

a. Pressure transmitter improperly located. Check for proper location, down stream and aft of lube filter and check valve. Relocate.

b. Clogged line aft of pressure transmitter. Check lines for restrictions and replace if necessary.

c. Oil temperature too low. Apply heat or run engine until oil temperature is within limits.

7-144. ENGINE WILL NOT OPERATE ON EMERGENCY SYSTEM. (-27 MODEL).

a. If upon switching from MAIN to EMERGENCY and engine continues to operate with no loss in RPM:

(1) If emergency light comes ON, compressor bleed solenoid is defective or defective circuit. Check circuit for continuity. If circuit checks OK, replace compressor bleed solenoid.

(2) If emergency light does not come ON and RPM remains constant, check power supply to fuel system selector switch. If power supply is all right, replace fuel system selector switch. If trouble still persists, proceed as in (1) above.

b. If upon switching from MAIN to EMERGENCY at full throttle, RPM drops to approximately 55 to 65 percent and remains at that speed;

(1) Rupured bellows in emergency fuel control. Replace emergency fuel control.

(2) Emergency pump sheared. Replace pump.

7-145. ENGINE STALLS ON ACCELERATIONS. (-27 MODEL).

a. Fuel system selector switch in ALERT position. Place switch in MAIN position.

b. Open circuit to emergency control by-pass solenoid. Check circuit, replace any defective lead.

c. Defective emergency control by-pass solenoid. Replace control if solenoid is defective.

d. Flow divider improperly adjusted. Adjust in accordance with applicable instructions.

7-146. ENGINE INTERNAL HOSE. The most common sources of engine noise or abnormal sounds are caused by the following:

a. Compressor and turbine.

b. Main bearings.

c. Starter-generator (bearings and brushes).

d. Accessory gear train.

e. Labyrinth air seals.

f. Splined joints or couplings.

g. Lube or scavenge pumps.

h. Turbine buckets.

i. Distorted shroud ring or segments.

7–147. ENGINE INTERNAL NOISES are characterized by the following:

a. Bearings emit a "clicking" sound by the balls or rollers hitting the spacer cage at low engine speeds or coastdowns.

b. Starter-generator emits a noise on the order of a "grinding" growl at about one-half the engine rotor cycle. This noise is more pronounced at low engine speeds or during coastdown.

c. Gear train emits a "grinding click" at low engine speeds or during coastdown.

d. Air seals emit a "rubbing" sound at the same frequency as the engine, in some cases this noise will disappear at various speeds. Serviceability of the rub can best be evaluated during idle speed or during coastdown after shutdown.

e. Couplings and splines emit a definite "bump" or "knuckling" sound at the engine rotor frequency and is most prevalent at coastdown after shutdown.

f. Turbine blades emit a "clicking" or "clattering" noise during coastdown.

g. The exhaust cone inner cone emits a "rubbing" sound at the same frequency as the engine rotor. This noise is caused by the inner cone being distorted through overtemperature and coming in contact with turbine blades.

Note

The above described noises can be defined by their respective noise frequency in relation to engine RPM.

7–148. Numerous methods have been used in reference to mechanical means of determining the quality of abnormal sounds of jet engines, such as electronic wave band analyzers, medical stethoscope, listening rods or tubes, decibel noise pressure meter set at a controlled distance and direction from the engine. These devices have numerous practical application but do not, however, have the ability to differentiate the quality or cause of internal noise.

7–149. The proper procedure for checking an engine for suspected noise is as follows:

a. With the engine operating at idle speed, stand close to the engine inlet and to one side.

b. If abnormal sounds are detected, determine the frequency of the noise in relation to engine speed. It may be necessary to lay a hand on the forward frame to assist in determining the noise frequency.

c. Shut engine down in accordance with specified instructions and listen to coastdown. If noise is not heard during the entire coastdown the engine is serviceable.

d. If a definite noise is heard during coastdown, analyze noise as to its frequency and possible location.

e. The quality of the noise should only be resolved by the most experienced men available.

TABLE XXXIII F. ENGINE TROUBLE SHOOTING

Probable Cause	Isolation Procedure	Remedy
PROBLEM IS: INSUFFICIENT OR NO RPM WHEN ATTEMPTING TO START ENGINE.		
CAUTION Do not engage the starter when any type of rotor seizure exists. Engaging the starter under these conditions may result in a burned out starter-generator. If any type of seizure is suspected, rotate the turbine wheel by introducing compressed air in the inlet or by reaching up the tailpipe with a short stick and rotating the turbine wheel.		
Icing in compressor due to inlet covers and/or jet nozzle plugs not being installed immediately after shutdown	If starter is under abnormal load, shut down the engine and visually inspect compressor blades for icing conditions.	Direct hot air into compressor inlet.
Shroud ring seizure caused by too sudden shutdown of the engine at previous operation or any condition which resulted in quick cooling of the shroud ring	If starter is under abnormal load, listen at turbine section for scraping of turbine buckets against shroud ring.	Allow the engine to cool. This should eliminate the trouble. If it does not, check bucket tip to shroud ring for proper clearance.

TABLE XXXIII F. ENGINE TROUBLE SHOOTING (Cont.)

Probable Cause	Isolation Procedure	Remedy
Shroud ring seizure caused by insufficient bucket tip clearance	Listen at turbine section for scraping of turbine buckets against shroud ring.	Remove tailpipe and exhaust cone and check bucket tip clearance. Replace shroud if necessary.
Air and oil seal rub	If starter is under abnormal load, listen for scraping of internal parts.	Reject engine to field maintenance shop.
Compressor rotor or other type of seizure	If starter is under abnormal load, listen for scraping of internal parts.	Reject engine to field maintenance shop.
If rotors turn freely:		
External source of power or faulty connections to power source	Check output of power supply. Check connections.	Repair or replace as required.
Starter switch, selector switch, master switch or interlock switches defective	Check continuity of switches individually to isolate defective switch.	Replace defective switch.
Starter-generator leads reversed	Check starter-generator leads for correct routing.	Connect starter-generator leads to proper terminals.
Starter-generator:	Check starter-generator.	Replace starter-generator in all these cases.
Pitted commutator		
Grounded, open, or short-circuited armature.		
Grounded, open, or short-circuited field winding		
Starter-generator brushes:	Check brushes.	
Improperly fitted		Reseat brushes.
Sticky or defective		Replace brushes.
Terminal screws loose		Tighten down screws.
Insufficient spring tension		Replace starter-generator.
PROBLEM IS: COMBUSTION DOES NOT OCCUR DURING ATTEMPTED START.		
Broken cable leading to ignition units, if spark probes do not fire	Check cable for exterior damage. Continuity check cable for defective wiring.	Repair or replace cable.
Burnt or broken insulation on high voltage cable to spark probe	Check for evidence of burnt or broken insulation.	Repair or replace defective cable as necessary.
Spark probes defective	Remove spark probes and check for insulation cracks and carbon loading or coking.	Replace defective spark probes.
Fuel nozzle defective	If the fuel flow and pressure is normal at 6% rpm and the ignition system is functioning properly, install a replacement set of fuel nozzles in the chambers containing the spark probes to determine if the trouble is faulty spray pattern.	Replace defective fuel nozzles.

TABLE XXXIII F. ENGINE TROUBLE SHOOTING (Cont.)

Probable Cause	Isolation Procedure	Remedy
Defective fuel supply system	Disconnect fuel supply line at No. 3 island and energize fuel boost pump. If there is no fuel flow, trouble-shoot cell fuel system.	Check lines for obstruction. Check for defective booster pump.
Engine fuel filter or bypass valve clogged	Check for evidence of fuel flow through fuel filter or bypass valve. If fuel flow is not present, filter or valve is clogged.	Clean fuel filter. Replace filter if necessary.
Fuel stopcock faulty or linkage incorrectly adjusted	Disconnect fuel outlet line from oil cooler. Open throttle and motor engine at 3 to 4% rpm. If there is no fuel flow, check the fuel stopcock. If stopcock linkage is rigged correctly, stopcock is faulty. With throttle in cutoff, disconnect fuel out line from stopcock and rotate engine with starter. If fuel flows, linkage is incorrectly rigged.	Replace fuel stopcock and/or adjust linkage.
Flow divider defective	Disconnect and cap large slot manifold line. If engine will not start, flow divider is defective.	Replace flow divider.
Drip valves stuck open, fuel flowing from overboard drain	Cap the discharge lines from the drip valves. If engine starts, drip valves are defective.	Replace defective drip valves.
Linkage to fuel regulator disconnected or jammed	Check fuel regulator linkage.	Adjust fuel regulator linkage.
Fuel regulator or fuel pressure control valve defective	If fuel regulator has been replaced, prime with oil. Install pressure gage in VCO line. If pressure is above 23 psi, fuel pressure control valve is defective. If below 23 psi, fuel regulator is defective.	Replace defective regulator or control valve. Check and replace diaphragm in control valve if ruptured.
Fuel regulator variable control oil lines crossed	Check lines to assure they are correctly installed.	Install lines at their correct ports.
PROBLEM IS: EXCESSIVE FUEL FLOW RESULTS IN HOT START.		
Stopcock defective or linkage incorrectly rigged	Check stopcock linkage. Disconnect fuel outlet line to stopcock and rotate engine with starter. Check for fuel flow with throttle in cutoff position.	Adjust stopcock linkage or replace defective stopcock.
PROBLEM IS: ENGINE WILL NOT REACH 100% RPM.		
Incorrect adjustment of high speed stop or engine throttle linkage	Check high speed stop setting with throttle in full rpm position. Check engine throttle linkage for incorrect installation and adjustment.	Adjust high speed stop. Rerig throttle linkage.
Inoperative centrifugal booster pump	Check for operation.	Replace if defective.
Leak in CDP line between compressor rear frame and fuel regulator	Check line and connections for leakage.	Replace line. Tighten connections.

TABLE XXXIII F. ENGINE TROUBLE SHOOTING (Cont.)

Probable Cause	Isolation Procedure	Remedy
Leak in VCO pressure line	Check for excessive oil flow from forward frame drain.	Replace VCO pressure line.
Incorrect adjustment of stopcock and fuel regulator linkage	Check stopcock and regulator for correct adjustment.	Adjust linkage if incorrect.
Fuel pressure control valve or fuel regulator defective	Install pressure gage in VCO line and in fuel line. Attempt to reach top speed; VCO pressure should be approximately 1/3 of fuel pressure plus 15 psi. If VCO pressure is high, control valve is defective. If VCO pressure is low, regulator is defective.	Replace defective regulator or control valve. Check and replace diaphragm in control valve if ruptured.
Plugged or stopped up fuel nozzles or fuel manifolds	Check nozzles and manifolds. (This condition is identified by excessive fuel pressure.)	Remove and replace nozzles or manifolds.
PROBLEM IS: ENGINE SPEED EXCEEDS 100% RPM AT FULL THROTTLE POSITION.		
Incorrect setting of engine high speed stop	Check high speed stop for correct adjustments.	Adjust high speed stop.
Tachometer indicator faulty	Calibrate tachometer indicator.	Replace faulty tachometer indicator.
Incorrect adjustment of fuel regulator linkage	Check regulator linkage for correct adjustment.	Adjust regulator linkage.
Fuel regulator defective	If check of high speed stop, regulator linkage, and adjustment of high speed stop fails to correct problem, regulator is defective.	Replace defective fuel regulator.
Overspeeding on emergency System:		
Faulty adjustment of emergency regulator control valve	Check linkage.	Adjust as necessary.
Air sensing line to emergency regulator open to atmosphere	Check line.	Correct or replace line as necessary.
Outside air temperature excessively hot. Emergency system not set to proper temperature curve	Check against curve.	Set linkage to proper temperature curve.
Ruptured fuel pressure sensing diaphragm		Replace emergency fuel regulator.
Fuel pressure sensing line broken or disconnected	Check line.	Connect or replace line as necessary.
Faulty emergency regulator		Replace emergency regulator.
PROBLEM IS: ENGINE SURGES OR HUNTS WITH FIXED THROTTLE SETTING.		
Test cell shutoff valve, boost pump, fuel filter, and/or engine fuel filter operating improperly	Check fuel inlet pressure gage. If it surges, isolate defective cell component.	Replace defective unit.
Fluctuation of small slot manifold pressure	Check small slot manifold pressure for surge.	Replace flow divider.
Fuel regulator defective		Replace fuel regulator.

TABLE XXXIII F. ENGINE TROUBLE SHOOTING (Cont.)

Probable Cause	Isolation Procedure	Remedy
Fuel control valve defective		Replace fuel presure control valve.
Choo-choo pulsating combustion	Check to see if accumulating sacks have lost pressure.	Replace accumulator sacks or drain fuel line hose-type surge dampener.
No orifice in VCO line (J47-27)	Check for presence of 0.060 orifice in elbow at VCO port on fuel regulator.	Install orificed elbow, P/N 414B175, in regulator VCO port.
Rpm surge while operating on the emergency fuel system only:		
Faulty emergency fuel regulator		Remove and replace emergency regulator.
Incorrect bleed plug		Install larger diameter bleed plug in emergency control.
PROBLEM IS: HIGH OIL PRESSURE.		
Oil pressure gage defective	Calibrate oil pressure gage.	Replace defective gage.
Oil jets or lines clogged	Check engine oil filter and external lines for foreign material.	Clean engine oil filter. Blow out restriction in line or jets. If trouble persists, reject engine.
Pressure transmitter improperly located	Check for proper location.	Install transmitter down stream and aft of lube filter and check valve.
Oil temperature too low	Check oil inlet temperature.	Run engine until oil temperature is within limits.
PROBLEM IS: LOW OR NO LUBRICATING OIL PRESSURE.		
Main lube and scavenge pump drive shaft sheared	Tachometer indicator indicates zero with engine operating.	Replace engine.
Air lock in lubrication line	Disconnect oil line at No. 3 island and motor engine with starter.	When air lock has been eliminated, reconnect line.
Faulty oil pressure gage	Calibrate gage.	Replace defective gage.
Insufficient or no oil to engine inlet	Check oil supply. Check boost pump (if applicable).	Fill oil tank. Replace boost pump.
PROBLEM IS: EGT OVER MAXIMUM.		
Exhaust nozzle area too small		Increase exhaust nozzle area.
Fuel nozzle defective	Read thermocouples individually.	Replace defective fuel nozzle.
Excessive shroud ring clearance	Check shroud ring for proper clearance.	Replace shroud ring.
Combustion chamber liners, transition liners defective, or turbine nozzle too large	If the above steps do not correct the problem, return engine to field maintenance shop.	Reject to field maintenance shop for repairs.
Dirty or corroded compressor blades	Inspect compressor blades for dirt and rust.	Perform internal cleaning per T.O. 2J-J1-24.
PROBLEM IS: ENGINE STALLS.		
Stall prevention switch not used	Determine if stall prevention is required.	Engine bleed OFF acceleration rates are not guaranteed below 59°F.
Acceleration time too fast	Check acceleration time.	Adjust flow divider, trimmer valve and/or CDP valve as necessary.

TABLE XXXIII F. ENGINE TROUBLE SHOOTING (Cont.)

Probable Cause	Isolation Procedure	Remedy
PROBLEM IS: OIL LEAKS IN VICINITY OF TURBINE FRAME.		
Defective large mid-frame O-ring or pulled studs on midframe.	Wipe oil from compressor rear frame. Run engine to determine that leakage occurs only during static conditions and that no leakage occurs during engine operation.	Replace O-ring. If stud collar is not below surface of midframe flange, return engine to depot for repairs.
	Note Engines exhibiting static oil leakage need not be replaced prior to next periodic inspection if the leakage does not constitute a fire hazard or cause excessive oil consumption.	
Defective O-ring at midframe/turbine frame oil supply port.	Leakage oil observed in flange area of oil supply port during engine operation.	Replace O-ring.
Improperly secured aft scavenge pump, or defective gasket.	Check for leakage in area of aft scavenge pump.	Remove pump. Determine that mating flange surfaces are free of defects. Replace gasket. Apply proper torque to mounting bolts.
PROBLEM IS: OIL LEAK FROM NO. 2 AIR-OIL SEAL VENTS AT MIDFRAME OR NO. 4 AIR-OIL SEAL VENTS ON TURBINE FRAME.		
	Note Engines exhibiting oil coming from the front frame or aft frame vents need not be replaced before the next periodic unless oil consumption exceeds limit.	
Positive air pressure in turbine frame.	Check turbine frame negative pressure on the installed engine at 100% RPM using a vacuum gage or a water manometer connected to pressure tap located between the breather assembly and the flange of the ejector line.	See below.
	Note If, after 5 minutes of operation at 100 percent rpm and using the vacuum gage (3, figure 2-16A) of the turbine frame vacuum test set, 1C1749, to read the turbine frame pressure, the pressure at the static pressure tap (7) between the breather assembly (5) and the ejector flange is not within -3 to -9 inches H_2O and the pressure taken at the tube to aft frame (6) is not within 0 to -6 inches H_2O, check for the following conditions:	
a. Insufficient air supply to ejector.	Inspect lines supplying air to small fitting on ejector for leaks and/or restrictions. Inspect gasket installation at breather assembly mounting flange. Ensure that screens P/N 8482877-2 have been removed, reference paragraph 4-332U.	Repair/replace items as required.
b. Low capacity or defective airframe ejector.	Check operation of ejector by replacing it with turbine frame test ejector, 1C1707.	Repair or replace ejector.

TABLE XXXIII F. ENGINE TROUBLE SHOOTING (Cont.)

Probable Cause	Isolation Procedure	Remedy
c. Damaged or worn air-oil seals or cracked turbine frame.	Leakage at No. 4 seal vents is indicative of failure of No. 2 air-oil seal. Leakage at No. 2 seal vents on compressor rear frame is indicative of failure of No. 4 air-oil seal area or cracks on the turbine frame at the No. 4 bearing area.	Return engine for No. 4 seal replacement. Replace No. 4 seal and/or turbine frame.

Note

The negative pressure on a normal engine with a satisfactory airframe ejector will stabilize in 5 minutes at 100 percent rpm approximately 4 inches below the initial negative pressure as the engine parts expand and reach maximum clearance. Installing an ejector with a known negative pressure capacity will speed the troubleshooting process. When satisfactory negative pressure is obtained and the oil leak transfers to the ejector, oil scavenging action should be checked. A vapor trail from the ejector is acceptable provided oil consumption is not excessive.

SECTION VIII
TABLE OF LIMITS

8-1. GENERAL.

8-2. Use the clearance limits, tables XXXIV through XXXVI, to determine the proper relationship between mating parts in any particular assembly. Those limits are not presented for dimensional inspection at the time of tear-down and reassembly, but should be used as a guide in cases of parts replacement or as a supplement to visual inspection in verifying serviceability of used parts. In most cases dimensional inspection is necessary only if difficulty is encountered during reassembly.

8-3. Use the torque values, tables XXXVIII through XLVIII, during engine assembly, as indicated in paragraphs 8-9 through 8-30.

8-4. The reference numbers in the left-hand column of the tables have been used throughout the text in referring to limits and torques.

Note

Clearance limits are given in inches and torque values in pound inches, unless otherwise indicated.

8-5. CLEARANCE LIMITS.

8-6. GENERAL. The limits prescribed contain the minimum clearances allowable between 2 parts, or, in diametral measurements, the minimum and maximum dimensional limits of any one part. Replacement of parts is governed by the tolerance given in the "Min" and "Max" columns. The limits, together with visual inspection, are the indispensable guide in determining the future use, repair, or rejection of a particular part, and must be followed throughout the inspection proceedings.

8-7. DEFINITIONS OF SYMBOLS AND TERMS.

a. The letter "A" indicates axial clearances, which are measured in a direction parallel to the rotor shaft.

b. The letter "R" indicates radial clearances, which are measured in a direction perpendicular to the rotor shaft and are the dimensional differences between radii.

c. The letter "D" indicates diameters which are measured in a direction perpendicular to the rotor shaft.

d. The column of "Serviceable Limits" indicates minimum and maximum dimensional limits or clearances permitted for parts that have been in service. If these limits are not exceeded and if no other damage is present, the part may be returned to service.

e. The abbreviations "OD" and "ID" are used to mean "Outside Diameter" and "Inside Diameter," respectively.

TABLE XXXIV. COMPRESSOR SECTION LIMITS

(See figure 8-1.)

Ref No.	Figure 8-1 Index No.	Description	Direction Measured	Serviceable Limits In Inches Min	Max
1	1	Compressor front frame rabbet to inlet guide vane flange rabbet	D		
		Front frame rabbet OD		18.795	18.800
		Inlet guide vane rabbet ID		18.800	18.803
2	2	Compressor rotor first stage wheel shelf to inlet guide vane seal ring	D		
		First stage wheel shelf OD		17.930	17.939
		Inlet guide vane seal ring ID (Any one diameter)		17.946	17.992
		(Avearge of 4 diameters)		17.956	17.980
3	3	Compressor rotor first stage wheel rim to inlet guide vane seal ring	A	0.039	0.134
4	4	Compressor front frame to inlet guide vane mounting sector	D		
		Front frame ID		31.515	31.547
		Inlet guide vane mounting sector OD		31.360	31.440

TABLE XXXIV. COMPRESSOR SECTION LIMITS (cont)
(See figure 8-1.)

Ref No.	Figure 8-1 Index No.	Description	Direction Measured	Serviceable Limits In Inches Min	Max
5	5	Compressor stator casing rabbet to compressor front frame rabbet	D		
		Compressor stator casing rabbet ID		31.875	31.883
		Front frame rabbet OD		31.868	31.875
6	6	Compressor rotor blade tips to compressor stator casing	R		
		Stage 1		0.053	0.083
		Stage 2		0.035	0.080
		Stage 3		0.026	0.069
		Stage 4		0.027	0.068
		Stage 5		0.027	0.068
		Stage 6		0.020	0.061
		Stage 7		0.017	0.061
		Stage 8		0.018	0.052
		Stage 9		0.018	0.052
		Stage 10		0.012	0.052
		Stage 11		0.010	0.047
		Stage 12		0.010	0.041
7	7	Compressor stator blade tips to compressor rotor spacers	R		
		Stage 1		0.030	0.135
		Stage 2		0.032	0.131
		Stage 3		0.030	0.129
		Stage 4		0.035	0.145
		Stage 5		0.034	0.133
		Stage 6		0.038	0.133
		Stage 7		0.037	0.126
		Stage 8		0.032	0.103
		Stage 9		0.033	0.110
		Stage 10 & 11 (shaft type)		0.025	0.084
		Stage 10 & 11 (curvic coupling)		0.035	0.084
		Stage 12 (To rear frame outer air seal)		0.003	0.057
		Exit stage (To compressor rear frame)		0.004	0.045
8	8	Compressor rear frame outer air seal to compressor rotor twelfth stage wheel rim	A	0.070	0.165
9	9	Compressor rear frame outer air seal to compressor rotor twelfth stage wheel outer shelf	D		
		Outer air seal ID (Part No. 9482029)		*23.767	*23.787
		(Part No. 124D810)		*23.772	*23.788
		Twelfth stage wheel outer shelf OD		23.737	23.757
10	10	Compressor rear frame outer rabbet to compressor stator casing rabbet	D		
		Rear frame outer rabbet OD		*29.485	*29.503
		Compressor casing rabbet ID		29.497	29.506
11	11	Compressor rear frame inner rabbet to compressor rear frame outer air seal rabbet	D		
		Rear frame inner rabbet OD		24.607	24.624
		Outer air seal rabbet ID (Part No. 9482029)		24.617	24.627
		(Part No. 124D810)		24.618	24.623
12	12	Compressor rotor twelfth stage wheel outer shelf to compressor rear frame inner air seal	D		
		Twelfth stage wheel outer shelf ID		23.404	23.414
		Inner air seal OD (Part No. 8992854)		*23.220	*23.252
		(Part No. 124D811)		*23.262	*23.282

*Average of 4 readings taken 45 degrees apart.

TABLE XXXIV. COMPRESSOR SECTION LIMITS (cont)

(See figure 8–1.)

Ref No.	Figure 8–1 Index No.	Description	Direction Measured	Serviceable Limits In Inches Min	Max
13	13	Compressor rear frame outer air seal rabbet to inner air seal	D		
		Rear frame outer air seal rabbet OD (Part No. 9482029)		*21.799	*21.809
		Inner air seal ID (Part No. 8992854)		21.806	21.812
		Rear frame outer air seal rabbet OD (Part No. 124D810)		*21.799	*21.809
		Inner air seal ID (Part No. 124D811)		21.806	21.812
14	14	Compressor rotor twelfth stage wheel inner shelf to outer air seal inner shelf	D		
		Twelfth stage wheel inner shelf ID		21.841	21.851
		Outer air seal inner shelf OD (Part No. 9482029)		*21.677	*21.708
		(Part No. 124D810)		*21.724	*21.744
15	15	Compressor rear frame rabbet to turbine frame rabbet	D		
		Rear frame rabbet ID		15.370	15.390
		Turbine frame rabbet OD		15.372	15.374
16	16	Bearing cap assembly rabbet to No. 2 bearing housing outer flange	D		
		Bearing cap assembly rabbet ID		10.7490	10.7524
		Bearing housing outer flange OD		10.7474	10.7487
17	17	No. 2 bearing outer oil seal rabbet to bearing cap assembly flange	D		
		Outer oil seal rabbet OD		8.7470	8.7485
		Bearing cap assembly rabbet ID		8.7490	8.7520
18	18	Compressor rear frame to No. 2 bearing housing	D		
		Rear frame ID		9.8720	9.8800
		Rear housing OD		9.8748	9.8770
19	19	Bearing housing to No. 2 bearing outer race	D		
		Bearing housing ID		7.8733	7.8753
		Bearing outer race OD		7.8735	7.8740
20	20	No. 2 bearing outer oil seal to deflector oil seal shelf	D		
		Outer oil seal OD		5.680	5.690
		Deflector oil seal shelf ID		5.750	5.755
21	21	Scavenge pump drive pinion (compressor rear frame)	D		
		Gear dia over 0.144 pins		6.0980	6.1110
22	22	Twelfth stage compressor wheel hub to turbine shaft pilot	D		
		Twelfth stage wheel hub ID		3.3740	3.3760
		Turbine shaft pilot OD		3.3720	3.3735
23	23	Scavenge pump drive pinion to twelfth stage compressor wheel pinion journal	D		
		Drive pinion ID		4.3280	4.3290
		Twelfth stage wheel pinion journal OD		4.3265	4.3280
24	24	Rear spline—compressor rotor	D		
		Spline dia under three 0.216 pins		2.8246	2.8334
25	25	Turbine shaft spline	D		
		Spline dia over 0.216 pins		3.4052	3.4140
26	26	No. 2 bearing inner race to twelfth stage compressor bearing journal	D		
		Bearing inner race ID		4.3304	4.3307
		Twelfth stage bearing journal OD		4.3306	4.3312

*Average of 4 readings taken 45 degrees apart.

TABLE XXXIV. COMPRESSOR SECTION LIMITS (cont)

(See figure 8-1.)

Ref No.	Figure 8-1 Index No.	Description	Direction Measured	Serviceable Limts In Inches Min	Max
27	27	Deflector oil seal to twelfth stage compressor wheel hub journal	D		
		Deflector oil seal ID		4.3742	4.3753
		Twelfth stage wheel journal OD		4.3730	4.3740
28	28	No. 2 bearing outer oil seal to twelfth stage compressor wheel hub	D		
		Outer oil seal ID		5.009	5.021
		Twelfth stage wheel hub OD		5.000	5.001
29	29	No. 2 bearing cap to deflector oil seal shelf	D		
		Bearing cap ID		6.131	6.143
		Deflector oil seal shelf OD		6.110	6.117
30	30	Compressor front frame rear inner seal to bearing oil seal shelf	D		
		Rear inner seal ID		3.886	3.901
		Bearing oil seal shelf OD		3.875	3.876
31	31	Compressor front frame rear inner seal to bearing oil seal hub	D		
		Rear inner seal ID		2.759	2.768
		Bearing oil seal hub OD		2.749	2.751
32	32	Compressor shaft to forward bearing oil seal hub	D		
		Compressor shaft OD		1.9684	1.9690
		Oil seal hub ID		1.9691	1.9697
33	33	Forward bearing inner race to compressor shaft	D		
		Bearing inner race ID		1.9682	1.9685
		Compressor shaft OD		1.9684	1.9690

TABLE XXXV. TURBINE SECTION LIMITS

(See figure 8-2.)

Ref No.	Figure 8-2 Index No.	Description	Direction Measured	Serviceable Limts In Inches Min	Max
34	1	Turbine casing flange to turbine frame rabbet	D		
		Turbine casing flange ID		35.497	35.505
		Turbine frame rabbet OD		35.487	35.497
35	2	Turbine nozzle inner flange rabbet to turbine frame adapter flange	D		
		Turbine nozzle inner flange rabbet ID		24.414	24.432
		Turbine frame adapter flange OD		24.400	24.415
36	3	Turbine casing aft flange and exhaust cone flange to turbine nozzle flange and shroud ring flange (standard shroud)	D		
		Turbine casing and exhaust cone flange ID		35.490	35.510
		Turbine nozzle and shroud ring flange OD		35.300	35.325

TABLE XXXV. TURBINE SECTION LIMITS (Cont.)
(See figure 8-2.)

Ref No.	Figure 8-2 Index No.	Description	Direction Measured	Serviceable Limits In Inches Min	Max
37	4	Shroud ring rabbet to turbine nozzle rabbet (standard)	D		
		Shroud ring rabbet ID		34.985	34.995
		Turbine nozzle rabbet OD (any one diameter)		34.950	34.990
38	5	Shroud ring ID	D	34.503	34.513
39	6	Turbine rotor to shroud ring (standard)	R		
		(At any one point)		0.045	0.140
		(Average of at least 4 equally spaced points)		0.058	
40	7	Shroud ring rabbet to turbine nozzle rabbet (floating)	D		
		Shroud ring rabbet ID		34.985	34.995
		Turbine nozzle rabbet OD (any one diameter)		34.895	34.970

TABLE XXXV. TURBINE SECTION LIMITS (Cont.)
(See figure 8-2.)

Ref No.	Figure 8-2 Index No.	Description	Direction Measured	Serviceable Limits In Inches Min	Max
41	8	Turbine casing aft flange to turbine nozzle flange (floating)	D		
		Turbine casing aft flange ID		35.490	35.510
		Turbine nozzle flange OD		35.300	35.325
42	9	Exhaust cone flange to shroud ring flange (floating)	D		
		Exhaust cone flange ID		35.594	35.614
		Shroud ring flange OD		35.300	35.325
43	10	Turbine rotor to shroud ring (floating)	R		
		(At any one point)		0.020	0.140
		(Average of at least 8 equally spaced points)		0.075	0.140
44	11	Turbine bucket circumferential tip movement (shake)			
		Before pinning or bending locking strip tab		0.016	0.125
		After pinning or bending locking strip tab		0.000	0.125
45	12	Turbine wheel OD	D	26.718	26.738
46	13	Turbine bucket dovetail movement (pinned wheels)	A	0.000	0.010
47	14	Locking strip tab projection (locking strip wheels)	A		0.070
48	15	Turbine wheel pin hole dia (pinned wheels)	D	0.1235	0.1340
49	16	Turbine rotor to turbine nozzle inner flange mounting bolt	A	0.419	0.608
50	17	Turbine rotor to turbine frame outer air baffle	A	0.275	0.452
51	18	Turbine rotor to turbine frame inner air baffle	A	0.644	0.829
52	19	Turbine rotor shelf to turbine rotor air seal	D		
		Turbine rotor shelf OD		10.743	10.750
		Air seal ID		*10.759	*10.779
53	20	No. 4 bearing housing aft rabbet to turbine rotor oil seal rabbet	D		
		Oil seal rabbet ID		9.248	9.253
		Bearing housing aft rabbet OD		9.243	9.246
54	21	Turbine shaft bolt rear guide to turbine shaft	D		
		Turbine shaft bolt rear guide OD		1.3035	1.3070
		Turbine shaft ID		1.3120	1.3135
55	22	Turbine frame oil seal to No. 4 bearing spacer	D		
		Turbine frame oil seal ID		6.634	6.650
		No. 4 bearing spacer OD		6.626	6.627

*Average of 4 readings taken 45 degrees apart.

TABLE XXXV. TURBINE SECTION LIMITS (cont)

(See figure 8–2.)

Ref No.	Figure 8–2 Index No.	Description	Direction Measured	Serviceable Limits In Inches Min	Max
56	23	No. 4 bearing outer race to bearing housing	D		
		Bearing outer race OD		6.6923	6.6929
		Bearing Housing ID		6.6929	6.6945
57	24	Turbine rotor shaft to bearing spacer hub	D		
		Turbine rotor shaft OD		3.7398	3.7407
		Bearing spacer hub ID		3.7412	3.7420
58	25	No. 4 bearing inner race to turbine rotor shaft	D		
		Bearing inner race ID		3.7398	3.7402
		Shaft OD		3.7398	3.7407
59	26	Turbine frame support ring No. 4 bearing housing	D		
		Support ring ID		9.436	9.441
		Bearing housing OD		9.440	9.443
60	27	Turbine shaft bolt ring to turbine shaft bolt	D		
		Turbine shaft bolt ring ID		1.3080	1.3090
		Turbine shaft bolt OD		1.3095	1.3105
61	28	Turbine shaft to turbine shaft bolt ring	D		
		Turbine shaft bolt ring OD		1.995	1.997
		Turbine shaft ID		1.999	2.004
62	29	No. 3 bearing outer race to bearing housing	D		
		Bearing outer race OD		6.2986	6.2992
		Bearing housing ID		6.2993	6.3006
63	30	No. 3 bearing shoulder ring rabbet to split ring	D		
		Shoulder ring rabbet ID		3.812	3.818
		Split ring OD		3.803	3.808
64	31	Split ring to ring seat on turbine rotor shaft	D		
		Split ring ID		3.250	3.254
		Split seat on shaft OD		3.235	3.250
65	32	Split ring to ring seat on turbine rotor shaft	A		
		Split ring width		0.247	0.249
		Ring seat width		0.250	0.259
66	33	Turbine rotor shaft No. 3 bearing shoulder ring	D		
		Turbine rotor shaft OD		3.5432	3.5438
		Shoulder ring ID		3.5440	3.5447
67	34	No. 3 bearing inner race to turbine rotor shaft	D		
		Bearing inner race ID		3.5429	3.5433
		Turbine rotor shaft OD		3.5432	3.5438

TABLE XXXVI. EXHAUST CONE LIMITS

(See figures 8–3 and 8–4.)

Ref No.	Fig. No.	Index No.	Description	Direction Measured	Serviceable Limits In Inches Min	Max
68	8–3 8–4	1	Exhaust cone front face of forward flange to inner cone assembly	A	2.703	2.766
69	8–3 8–4	2	Exhaust cone front face of forward flange to outer deflector	A	2.500	2.875
70	8–3 8–4	3	Exhaust cone front face of forward flange to cooling air deflector	A	3.500	3.875

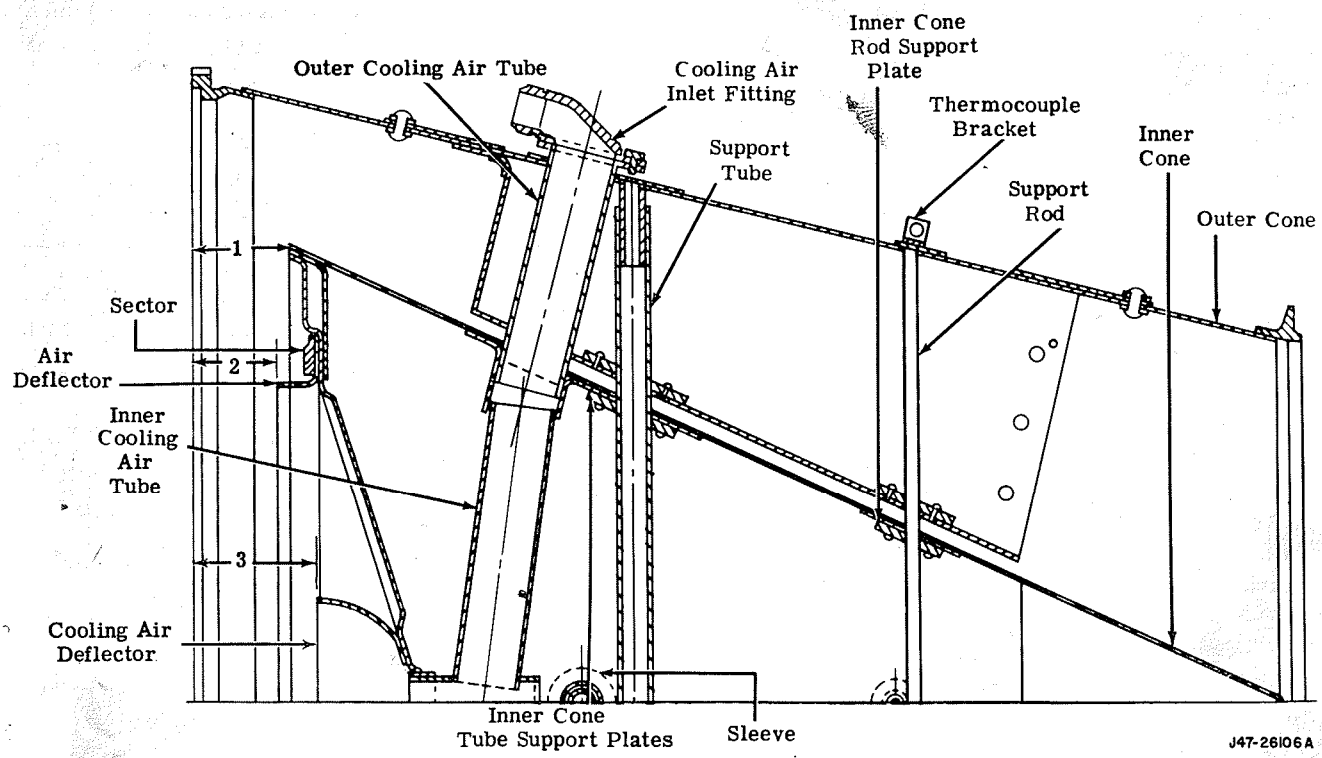


Figure 8-3. Welded Exhaust Cone Limits

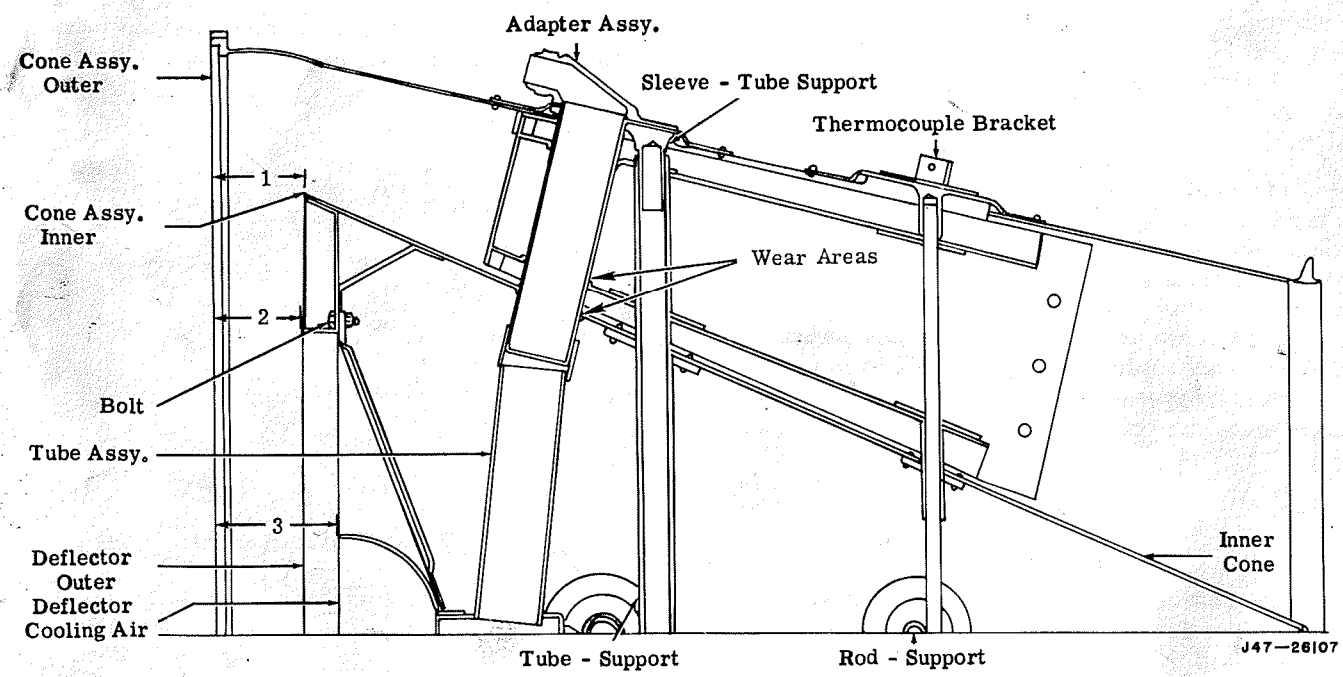


Figure 8-4. Channel Fairing Exhaust Cone Limits

8–8. TORQUE VALUES.

8–9. GENERAL.

8–10. TENSILE LOAD (TORQUE). Tensile load, or torque, is expressed in pound inches or pound feet. One pound inch or foot is the force of one pound applied to a bolt with one inch or foot of leverage. This force is applied to prevent either the bolt, or the component the bolt is securing, from coming loose.

8–11. DETERMINATION OF TORQUE. The amount of torque applied to a bolt or screw is governed by 4 factors:

a. The material of the fastener

b. The nominal diameter of the fastener

c. The number of threads per inch of the fastener

d. The material of the component, in the case of body bound bolts, or the material and thickness of the nut, in the case of fasteners used with nuts.

8–12. TORQUE PROCEDURE. Tighten at a uniformly increasing rate until the desired torque is obtained. In some cases, where gaskets or other parts cause a slow permanent set, it will be necessary to hold the torque at the desired value until the material is seated.

8–13. RECOMMENDED TORQUE PRACTICE. When applying torque to a series of bolts on one flange, or in one area, select a nominal value within the specified range and torque all bolts in the series to that value. This practice is recommended because it is possible to torque a series of bolts to values within the specified range and still create an undesirable condition. For instance, if some of the bolts in a series are torqued to the minimum value and the others to the maximum value, the danger of the bolts shearing or snapping off under normal working load is increased. This danger exists because the force which should be evenly distributed between all bolts of the series will be concentrated on the tighter bolts.

8–14. TORQUE LIMITS. Tightening to the final torque value during the first drawdown is undesirable because uneven tension may cause distortion or overstressing of parts. Seat and torque mating parts properly by drawing down the bolts or nuts gradually until the parts are firmly seated. Then loosen each one separately and apply final torque. Tightening in a diametrically opposite or staggered sequence is desirable in most instances. Do not exceed listed maximum torque.

CAUTION

When chilling or heating engine parts during assembly, do not torque locknuts or retaining bolts until the part has returned to room temperature. If the part is heated, the tightened fastener may loosen as the part cools. If the part is chilled, the tightened fastener may be overstressed as the part expands.

8–15. SUGGESTED TORQUE WRENCH SIZES. The torque wrenches listed in table XXXVII are recommended for use within the indicated range. Larger wrenches will have too great a tolerance and thereby be too inaccurate.

TABLE XXXVII. SUGGESTED TORQUE WRENCH SIZE

Torque Between	Torque Wrench	Tolerance
0 and 25 lb in.	30 lb in.	± 1 lb in.
25 and 140 lb in.	150 lb in.	± 5 lb in.
140 and 550 lb in.	600 lb in.	±20 lb in.
30 and 140 lb ft	150 lb ft	± 5 lb ft
140 and 240 lb ft	250 lb ft	±10 lb ft
240 and 1000 lb ft	1000 lb ft	±20 lb ft

8–16. USE OF OFFSET EXTENSIONS (CROWFEET). When an offset extension is used with a torque wrench, the effective length of the wrench is changed. The wrench is so calibrated that the indicated wrench torque (torque which appears on dial or gage of wrench) may be different from the actual amount of torque applied to the nut or bolt when an extension is used. Therefore, when an offset extension is used, the wrench must be set to compensate for the increase or decrease in actual torque, as compared to indicated torque. Use the following formula to compute the proper adjustment:

$$T = X\left(\frac{L \pm E}{L}\right) \text{ or } X = \left(\frac{T}{\frac{L \pm E}{L}}\right)$$

T = actual (desired) torque

$L = 8.4375$

$E = 1.5$

$$265 \text{ lb in.} = X\left(\frac{8.4375 + 1.5}{8.4375}\right) \text{ or}$$

$$\left(\frac{265}{\frac{8.4375 + 1.5}{8.4375}}\right)$$

$$X = \left(\frac{265}{9.9375} \right) \text{ or } X = \left(\frac{265}{1.1777} \right)$$

$X = 225$ lb in.

8–17. MEASURING EFFECTIVE LENGTH OF CROW-FOOT. The addition or subtraction of the effective length of the offset extension (E) is determined by the position of the extension on the wrench. When extension is pointed in same direction as wrench (figure 8–5), add the effective length of the extension to the effective length of the wrench (L + E). When extension is pointed back toward handle of wrench (figure 8–5), subtract effective length of extension from effective length of wrench (L —E). When extension is at right angles to wrench (figure 8–5), the actual value does not change, so no new value need be computed. The effective length of the torque wrench is a variable, and a different figure will be used for each type wrench. This figure may be found in the publications covering torque wrenches. The effective length of crow-foot may be determined by measuring from the center of socket opening to the center of wrench opening (figure 8–6).

8–18. SPECIAL TORQUE VALUES.

8–19. SPECIAL TORQUE TABLES. The special torque values given in this section are in tables XXXVIII and XXXIX, listed by engine section, beginning at the front and working aft. Reference to these tables is made throughout Sections V and VI.

8–20. ACCESSORY TORQUE VALUES. Use the torque values listed in table XXXIX for accessories covered in Section IV. The torque values given for each accessory apply to all listed models of the accessory, unless otherwise indicated.

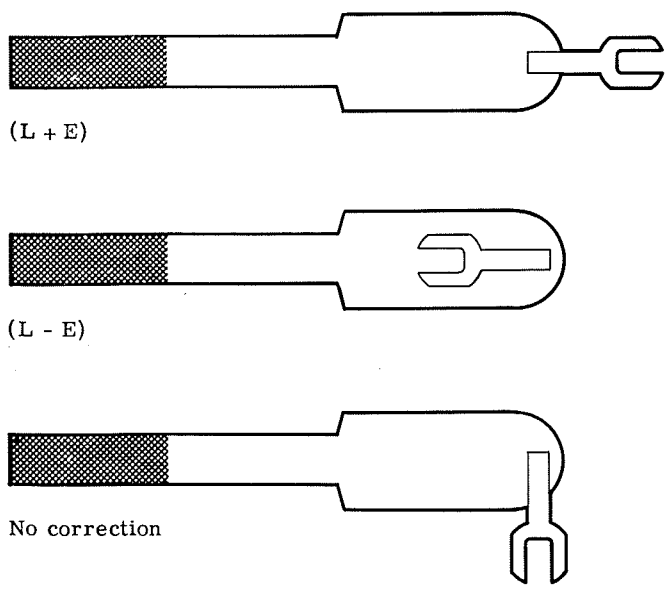


Figure 8–5. Use of Crow Foot Extensions

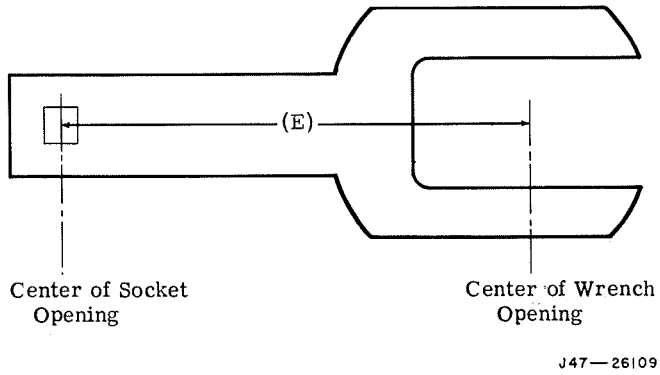


Figure 8–6. Measuring Effective Length of Crow Foot

8–21. STANDARD TORQUE VALUES.

8–22. STANDARD TORQUE TABLES. The standard torque values given in the section are in 9 tables, and comprise a general listing of torque values for standard bolts, nuts, fittings, and for various thread, bolt, and tube sizes.

8–23. STANDARD TORQUE PRACTICES. Use the torque values given in table XL for standard nuts and bolts (steel). For nuts and bolts of alloys other than steel and for all bolts threaded directly into aluminum, magnesium, or nonferrous alloys, use one-half of the torque listed. Use the values listed in table XLI for aluminum and steel tubing and hose end fittings. Use the values listed in table XLII for self-locking nuts.

Note

When self-locking nuts are used, the values in table XLII will be the controlling factor and not the bolt torques given in table XL.

8–24. TORQUE VALUES FOR STUD BOLTS THREADED INTO ALUMINUM AND MAGNESIUM. Use the torque values given in table XLIII for stud bolts threaded into aluminum and magnesium.

CAUTION

Do not exceed these minimum values any more than necessary to obtain the required minimum torque (125 percent of minimum nut torque), as some of them are near the yield point of the material.

8–25. TORQUE VALUES FOR STEPPED STUDS, NUT END, AND LOCK-THREAD STUDS. Use the values listed in table XLIV for stepped studs, nut ends, and lock-thread studs threaded into aluminum and magnesium. Torque values listed are for studs that are not held in position by a locking device but simply by an interference fit between mating parts. Coat all studs with compound, JAN–A–669, or zinc-chromate primer before installing them into magnesium. Install plated studs into aluminum without applying any compound or primer. Coat unplated studs with zinc-chromate primer, Specification MIL–P–6889, or thread compound, JAN–A–669, before installing them into aluminum.

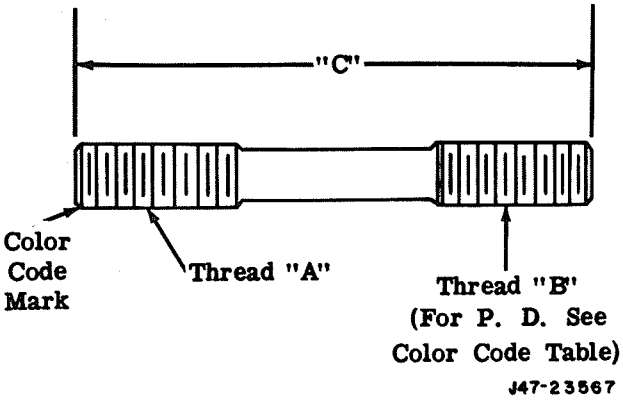


Figure 8–7. Stud Bolts in Aluminum and Magnesium

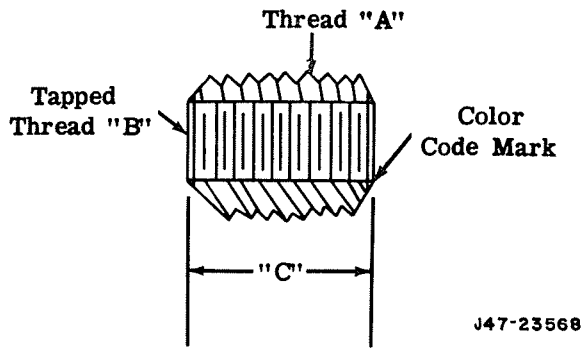


Figure 8–8. Screw Bushings (Threaded Inserts)

Note

Torque studs, manufactured to 2 different thread sizes on opposite ends, to the smaller size, regardless of which parts are fitted into the installation.

8–26. STUD BOLTS IN ALUMINUM AND MAGNESIUM. Use the dimensions listed in table XLV to select the proper size stud. In the table, the part numbers of the studs are listed in the first line. Included under the numbers are thread sizes, diameters, and color codes. (See figure 8–7.)

8–27. TORQUE VALUES FOR JAM NUTS USED ON FITTINGS WITHOUT GASKETS. Use the values listed in table XLVI for jam nuts used on fittings used without gaskets. Use steel torque values only where both the mating threads are steel. In all other cases, use torque values for aluminum.

8–28. ASSEMBLY OF THREADED BUSHING INSERTS. All screw bushings (threaded inserts) have 5 pitch diameter classifications or sizes. Each size is identified by color. Select the proper size so that the bushing will have a definte interference fit when assembled in the mating tapped hole before the locking pin is inserted. Avoid an excessive interference fit that could damage the parent part. Use the diameters listed in table XLVII to determine the proper insert. (See figure 8–8.)

8–29. TORQUE VALUES FOR JAM NUTS USED ON FITTINGS WITH GASKETS. Use the values given in table XLVIII for jam nuts used on fittings with gaskets. (See figure 8–9.)

8–30. ASSEMBLY OF GASKET AND PIPE THREAD FITTINGS. Assemble fittings as shown in figures 8–10 through 8–12.

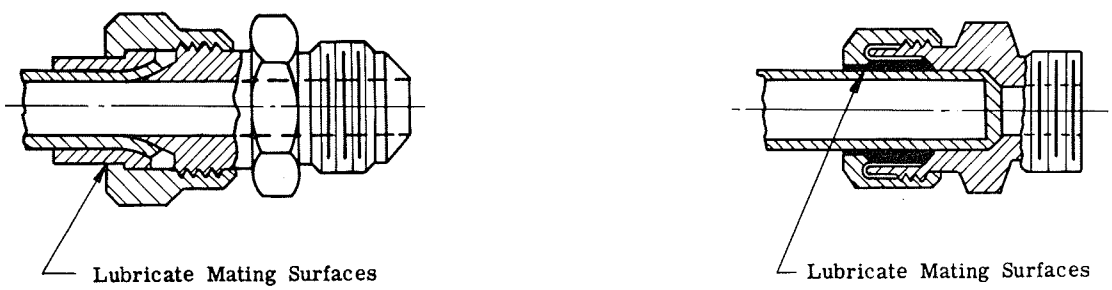
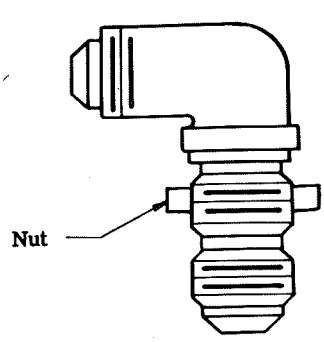
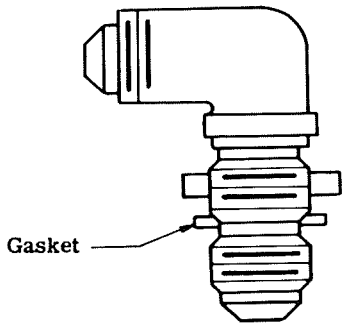

Lubricate Mating Surfaces
Lubricate Mating Surfaces
Run Nut Down To Full Torque, Then Back Off One Quarter Turn. Tighten Again To Full Torque Value.
J47-23106

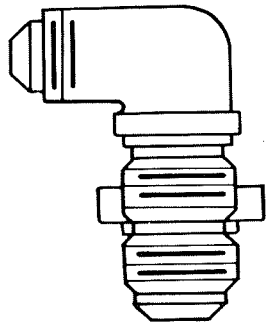
Figure 8–9. Flared Tubing and Fittings



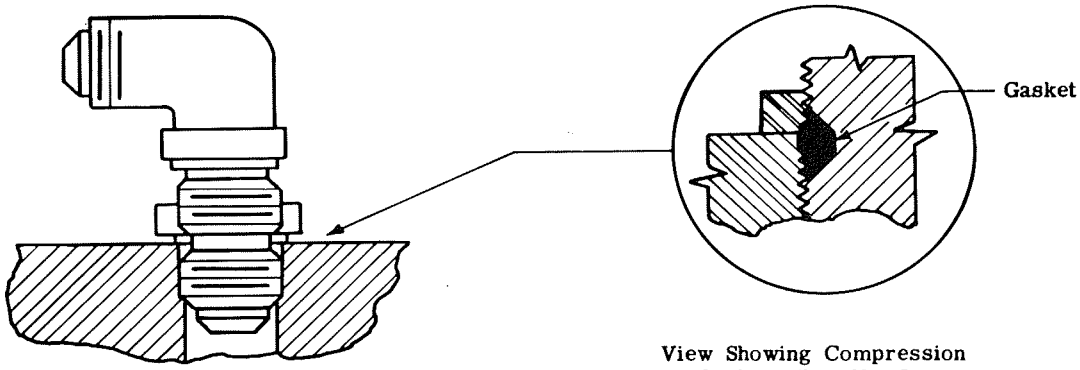
Operation 1. Assemble Nut On Fitting, Running Nut Well Up On Upper Thread. Apply A Very Small Amount Of Bolt Lube To Threads.



Operation 2. Assemble Gasket Snug Up Against Upper Threads Making Sure Gasket Is Not Twisted.



Operation 3. Run Nut Down Until It Just Touches Gasket.

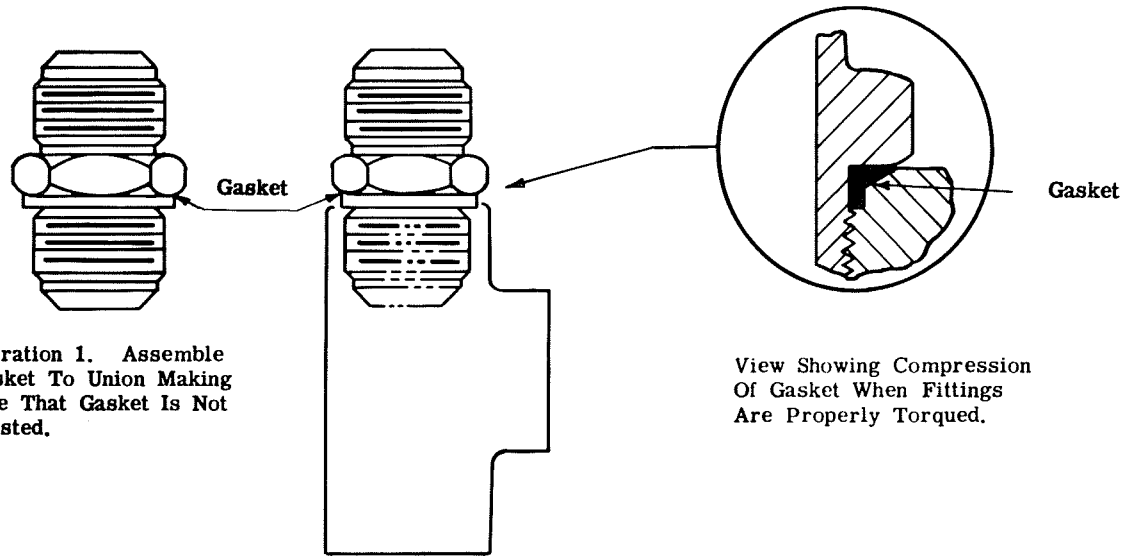


View Showing Compression Of Gasket When Nut Is Properly Torqued.

Operation 4. Assemble Fitting Into Casting Turning Down Until Gasket Just Contacts Casting. If Position Of Fitting Is Not Correct, Back Out (Counter Clockwise) Until Fitting Is In Proper Position. Tighten Nut To Proper Torque Value. Caution - Do Not Back Out More Than One Turn.

J47-23107

Figure 8-10. Assembly of Fittings Using Jam Nut and Gasket



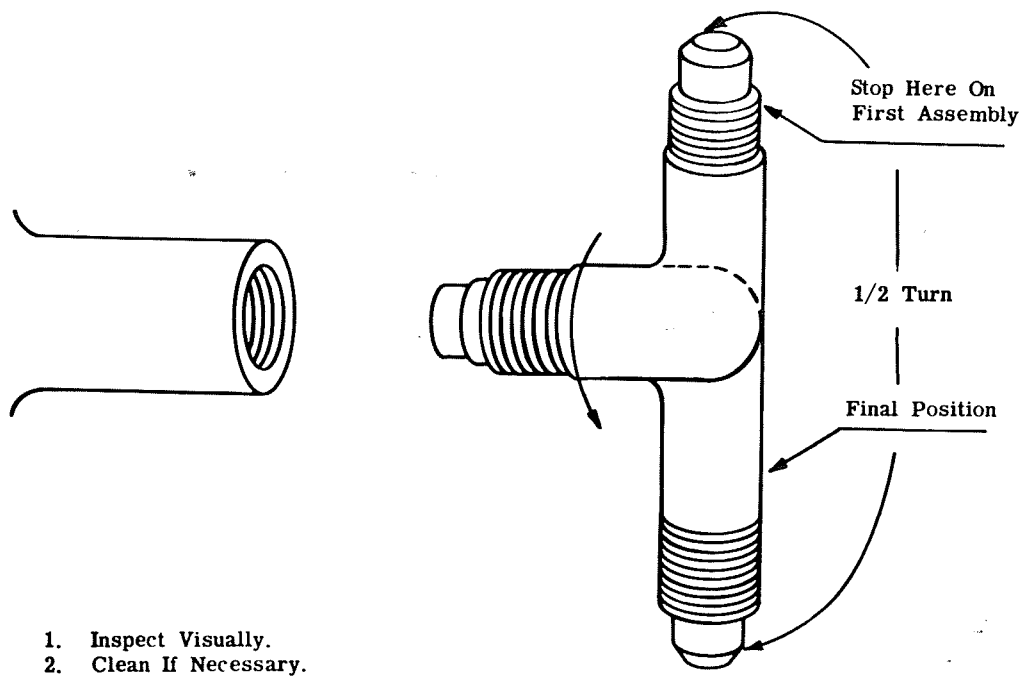
Operation 1. Assemble Gasket To Union Making Sure That Gasket Is Not Twisted.

View Showing Compression Of Gasket When Fittings Are Properly Torqued.

Operation 2. Assemble Union To Tee Applying A Very Small Amount Of Bolt Lube To Threads And Tighten To Proper Torque Value.

J47-23108

Figure 8-11. Assembly of Unions with Gaskets



1. Inspect Visually.
2. Clean If Necessary.
3. Lubricate.
   A. On Fittings Used On Compressor Castings And Gear Sets Use Bolt Lube.
   B. On Fittings Used On Aft Frames Use Crane's Compound.
4. Assemble Fitting, Screwing Down To Within 1/2 Turn Of Final Position.
5. Remove, Clean And Inspect Male Thread.
6. Relubricate.
7. Re-Assemble And Wrench To Final Location.

J47-23109

Figure 8-12. Assembly of Pipe Thread Fittings

TABLE XXXVIII. SPECIAL TORQUES

Ref No.	Name	Thread Size	Torque lb in.
	AUXILIARY DRIVE		
71	Screw—Accessory support mount	1/4-28	30-60
72	Bolt—Gear case scavenge oil pump	10-32	24-27
73	Nut—Hydraulic pump cover	5/16-24	80-130
74	Bolt—Regulator oil filter to bracket	1/4-28	36-70
75	Bolt—Regulator oil filter bracket to mount	1/4-28	36-70
76	Bolt—Fuel filter to bracket	5/16-24	80-130
77	Bolt—Fuel filter bracket to mount	1/4-28	36-70
78	Bolt—Fuel pressure control valve to mount	5/16-24	80-130
79	Screw—Alternator shipping cover	3/8-24	190-230
80	Bolt—Alternator drive housing to mount	1/4-28	36-70
81	Bolt—Hydraulic pump drive elbow (loc-o-seal)	10-32	24-27
	ACCESSORIES TO FRONT FRAME		
82	Nut—Auxiliary hydraulic pump cover	5/16-24	80-130
83	Nut—Starter-generator mounting bracket to front frame	3/8-24	190-230
84	Screw—Starter-generator air outlet duct to mounting bracket	10-32	24-27
85	Nut—Tachometer-generator to lube pump	1/4-28	36-70
86	Nut—Lube oil pump to front frame	5/16-24	80-130
87	Nut—Fuel pump to front frame	5/16-24	80-130
88	Bolt—Stopcock to main fuel regulator	1/4-28	36-70
89	Nut—Main fuel regulator to front frame	5/16-24	80-130
90	Bolt—Flanged connector to fuel control valve	1/4-20	30-60
91	Bolt—Flanged connector to fuel pump	5/16-24	80-130
92	Bolt—Flanged connector to oil pump	5/16-24	80-130
93	Bolt—Starter-generator leads to generator		100-105
94	Nut—Shunt field lead to generator	10-32	24-27
95	Nut—Quick-disconnect clamp on generator		85-95
	AIR INLET SECTION		
96	Bolt—Accumulator cowl guide to sector	1/4-28	36-70
97	Screw—Accumulator cowl guide	10-32	24-27
98	Clamp—Accumulator tube		15-20
99	Cap—Accumulator cylinder		100-125
100	Screw—Screen actuator to housing	10-32	24-27
101	Screw—Outer housing to inner housing	10-32	24-27
102	Bolt—Inner housing to bearing and sector	1/4-28	36-70
103	Screw—Actuator motor to front frame	1/4-28	36-70
104	Bolt—Flexible shaft bracket to front frame	1/4-28	36-70
105	Screw—Air inlet duct baffle	1/4-28	36-70
106	Bolt—Air inlet sectors to front frame	1/4-28	36-70

TABLE XXXVIII. SPECIAL TORQUES (cont)

Ref No.	Name	Thread Size	Torque lb in.
107	Cap—Screen actuator jack		Finger tight and back off 1/4 turn.
108	Nut—Flexible shaft holding bracket	10–32	24–27
	MAIN FUEL THROTTLE LINKAGE		
109	Screw—High speed stop adjusting	10–32	24–27
110	Screw—High speed stop to sector	10–32	24–27
111	Bolt—Thread shaft bearing retaining	1/4–28	36–70
112	Bolt—Escutcheon plate retaining	10–32	24–27
113	Screw—Adjusting pin set (—25A only)		no valve
114	Bolt—Throttle arm to power shaft (—25A only)	10–32	24–27
115	Bolt—Fuel regulator clevis (bearing)	10–32	24–27
116	Bolt—Fuel regulator clevis at control shaft	1/4–28	36–70
117	Bolt—Stopcock clevis (bearing)	10–32	24–27
118	Bolt—Stopcock clevis (at stopcock)	1/4–28	36–70
119	Bolt—Stopcock clevis (at control shaft)	1/4–20	36–70
120	Nut—Rod lever (stopcock and fuel and regulator)	1/4–28	36–70
121	Bolt—Control shaft clevis (bearing)	10–32	24–27
122	Bolt—Control shaft clevis	1/4–28	36–70
123	Bolt—Clevis at fuel regulator	10–32	24–27
	EMERGENCY FUEL THROTTLE LINKAGE		
124	Nut—Control shaft clevis to splined arm	1/4–28	36–70
125	Bolt—Splined arm to control shaft	1/4–28	36–70
126	Bolt—Rod bearing to clevis	10–32	24–27
127	Nut—Push rod bearing	1/4–28	36–70
128	Bolt—Control lever pointer	10–32	24–27
129	Nut—Pointer to main control shaft	10–32	24–27
	COMPRESSOR FRONT FRAME (External)		
130	Screw—Compressor front frame vent cover	8–32	13–16
131	Screw—Gear case balance air port	1/4–32	36–70
132	Screw—Static pressure tap boss	10–32	24–27
133	Bolt—Double tee oil drain connector	10–32	24–27
134	Bolt—Air inlet duct fairing bracket	1/4–28	36–70
135	Screw—Anti-icing air duct	8–32	13–16
136	Bolt—Compressor inlet guide vane	1/4–28	36–70
137	Nut—Flanged offset tee connector	1/4–28	36–70
138	Cap—Accessory drive front bearing	4.250–16	600
139	Valve—Compressor front frame check	1-1/16–12	200–250
140	Valve—Relief	1-1/16–12	200–250
141	Plug—Magnetic drain	1/2–20	40–60

TABLE XXXVIII. SPECIAL TORQUES (cont)

Ref No.	Name	Thread Size	Torque lb in.
	COMPRESSOR CASING		
142	Bolt—Lube oil filter to casing	1/4-28	36-70
143	Bolt—Anti-icing air valve	1/4-28	36-70
144	Bolt—Fuel flow divider to oil cooler	5/16-24	80-130
145	Bolt—Fuel inlet elbow to oil cooler	1/4-28	36-70
146	Bolt—Oil cooler to casing	5/16-24	80-130
147	Bolt—Junction box to casing	1/4-28	36-70
148	Screw—Air valve solenoid bracket to air valve	10-32	24-27
149	Bolt—Ignition coil bracket to casing	1/4-28	36-70
150	Bolt—Emergency fuel regulator to casing	1/4-28	36-70
151	Bolt—Ignition vibrator and bleed valve to casing	1/4-28	36-70
152	Nut—Vertical split line	3/8-24	110-115
153	Nut—Horizontal split line	3/8-24	110-115
154	Bolt—Vertical split line	3/8-24	105-110
155	Bolt—Eighth and twelfth stage air extraction covers	1/4-28	36-70
	COMPRESSOR ROTOR		
156	Nut—No. 2 bearing spanner	4.325-12	1800-4800*
157	Nut—No. 1 bearing locknut	1.815-18	600-2400*
			*Torque to min. value and attempt safety. Continue to torque until possible to safety. Do not exceed max value.
	COMPRESSOR REAR FRAME		
158	Bolt—Scavenge pump to compressor rear frame	5/16-24	155
159	Plug—Gear housing drain	1/2-20	110
160	Bolt—Scavenge gear train to compressor rear frame	5/16-24	75-85
161	Bolt—Rear frame oil shield	5/16-24	75-85
162	Bolt—Fuel nozzle to compressor rear frame	1/4-28	36-70
163	Bolt—Gear case cover to scavenge gear train	10-32	24-27
164	Bolt—Twelfth stage leakage cover	1/4-28	36-70
165	Bolt—Air take-off manifold cover	1/4-28	36-70
166	Screw—Inlet duct screens on compressor rear frame	8-32	13-16
167	Screw—No. 2 bearing cover and housing retaining	1/4-28	36-70
168	Bolt—Compressor rear frame outer seal	1/4-20	36-70
169	Union—With silicon seal on scavenge pump	1-1/16-12	125
	COMBUSTION CHAMBERS		
170	Nut—Drain tube fitting on chamber	7/16-20	170-200
171	Screw—Cross-ignition tubes (bellows type only)	1/4-20	60-75
172	Screw—Igniter plug	1/4-20	60-75

TABLE XXXVIII. SPECIAL TORQUES (Cont.)

Ref No.	Name	Thread Size	Torque lb-in.
173	Clamp-Cross-ignition Marmon (elliptical only)	10-32	25-30
174	Clamp-Front and rear Marmon on combustion chamber	1/4-28	40-60
175	Bolt-Exit ring (elliptical only)	1/4-20	40-60
176	Bolt-Inner liner securing (bellows type only)	1/4-20	40-60
177	Nozzle-Water-alcohol injection on chamber	9/16-24	170-200
178	Plug-Water-alcohol injection on chamber	9/16-24	170-200
	TURBINE FRAME		
179	Bolt-Inner band (annular system only)	10-32	24-27
180	Nut-Annular transition liner securing	1/4-28	36-70
181	Screw-Outer band (annular system only)	10-32	24-27
182	Nut-Turbine frame to compressor rear frame	7/16-20	400-425
183	Bolt-Turbine frame oil drain and filter	10-32	24-27
184	Bolt-Cooling air bellows	1/4-28	25-35
185	Nut-Turbine frame breather	1/4-28	36-70
186	Nut-Turbine casing to turbine frame	1/4-28	40-50
186A	Nut-Turbine casing to exhaust cone	1/4-28	50-70
187	Bolt-No. 2 oil jet bracket	1/4-28	36-70
188	Nut-No. 2 bearing oil jet coupling		75-125
189	Screw-Forward shield attaching	10-32	24-27
190	Nut-Damper bearing springs	5/16-24	85 lb-in. then back off 1/2 to 3/4 turn.
191	Bolt-Damper bearing ring to housing	10-32	24-27
192	Nut-Coupling on No. 2 bearing oil tube at inlet		75-125
193	Nut-Coupling on No. 4 bearing oil tube		55
194	Nut-Coupling on No. 3 bearing oil jet		55
195	Nut-Coupling on No. 2 bearing oil tube at oil tee		55
196	Screw-Anchor nut plate	10-32	Fully engaged, but not tight.
197	Nut-Water-alcohol injection tube cover	5/16-24	130-180
198	Bolt-No. 4 bearing retaining ring	1/4-28	36-70
199	Screw-No. 4 air-oil seal	1/4-28	36-70

TABLE XXXVIII. SPECIAL TORQUES (Cont.)

Ref No.	Name	Thread Size	Torque lb-in.
200	Bolt-Turbine nozzle and air deflector to turbine frame	1/4-20	50-70 and loosen. Retorque to 25-35
	TURBINE ROTOR		
201	Bolt-Turbine wheel tie	1.250-8	4080
202	Nut-Turbine wheel tie-bolt	1.250-8	3840 and loosen retorque to 1080-2100.
203	Nut-No. 4 bearing lock	3.683-12	1440-2280
204	Nut-No. 3 bearing lock	3.480-12	900
205	Screw-No. 3 bearing locknut set	1/4-20	55-65
206	Clamp-Exhaust cone to tailpipe, Marmon	1/2-13	130-150 and loosen; retorque to 70-75. Do not retorque after final torque.
207	Bolt-Turbine rotor shipping container	5/8-11	80-100
	OUTSIDE PIPING		
208	Nut-Cooling air tube, turbine rotor at exhaust cone	1-5/16-12	420
209	Nut-Packing, cooling air tube between No. 1 and No. 2 combustion chambers	1-7/8-12	Snug slip-fit
210	Elbows and Hose-Large slot fuel nozzle port	9/16-18	200
211	Elbows and Hose-Small slot fuel nozzle port	7/16-20	100
212	Leads-Igniter plug	3/4-20	110
213	Plugs-Cannon, electrical		Fingertight
214	Clamps-Hose		15-20
215	Connectors-Anti-icing swivel, to island fairing		Fingertight
	EXHAUST CONE		
216	Nut-Support tube sleeve	1/4-28	36-70
217	Bolt-Nut plate sector	1/4-28	36-70
218	Bolt-Outer air deflector	1/4-28	36-70
219	Turbine strongback		50; loosen and retorque to 25.

TABLE XXXIX. ACCESSORY TORQUE VALUES

Ref No.	Nomenclature	Model No.	Vendor	Torque Location	Torque lb-in.
220	Accumulator-Cowl guide	303D126	GE	Union to cap	100-125
221	Valve-Compressor discharge pressure	414B199	GE	Locknut Nut cap	25-30 20-25
222	Valve-Fuel regulator	326C338	GE	Jam nut	30-60
223	Valve-Check, main fuel	414B481	GE	Cap Sub-Assembly Union	145-155 90-105
224	Filter-Regulator oil	OS12223G	Air-Maze	Nut Sump to body	10-15 120-168
		3856	Hydro-Aire	Orifice assembly to sump Nut	40-50 40-60
225	Filter-Lube oil	C15575K	Air-Maze	Cover nut Seal nut	70-80 25-30
		3690	Hydro-Aire	Cover seat	90-110

TABLE XL. TORQUE VALUES FOR STANDARD NUTS AND BOLTS (STEEL)

NC and 8 Series Threads Per inch	Torque	Bolt Size	NF and 12 Series Threads Per inch	Torque
32	13-16 lb-in.	8	36	16-19 lb-in.
24	20-23 lb-in.	10	32	24-27 lb-in.
20	30-60 lb-in.	1/4	28	36-70 lb-in.
18	70-110 lb-in.	5/16	24	80-130 lb-in.
16	160-210 lb-in.	3/8	24	190-230 lb-in.
14	250-320 lb-in.	7/16	20	290-360 lb-in.
13	420-510 lb-in.	1/2	20	480-570 lb-in. (40-48 pound-feet)

TABLE XL. TORQUE VALUES FOR STANDARD NUTS AND BOLTS (STEEL (cont)

NC and 8 Series Threads Per inch	Torque	Bolt Size	NF and 12 Series Threads Per inch	Torque
12	48 – 57 lb ft	9/16	18	55 – 65 lb ft
11	70 – 80 lb ft	5/8	18	82 – 95 lb ft
10	135 – 150 lb ft	3/4	16	150 – 165 lb ft
9	205 – 230 lb ft	7/8	14	235 – 265 lb ft
8	300 – 340 lb ft	1	14	350 – 400 lb ft
7	415 – 480 lb ft	1-1/8	12	485 – 565 lb ft
7	600 – 700 lb ft	1-1/4	12	690 – 800 lb ft
6	1000 – 1200 lb ft	1-1/2	12	1200 – 1400 lb ft
8	440 – 510 lb ft	1-1/8		
8	625 – 725 lb ft	1-1/4		
8	1150 – 1350 lb ft	1-1/2		

TABLE XLI. TORQUE VALUES FOR ALUMINUM AND STEEL TUBING AND HOSE END FITTINGS

AN Dash No.	Tubing OD Inches	Wrench Torque for Tightening AN818 Nuts: Aluminum Alloy Tubing Torque (lb in.) Min	Aluminum Alloy Tubing Torque (lb in.) Max	Steel Tubing Torque (lb in.) Min	Steel Tubing Torque (lb in.) Max	Hose End Fittings and Hose Assemblies Torque (lb in.) Min	Hose End Fittings and Hose Assemblies Torque (lb in.) Max
— 3	3/16			90	100	70	100
— 4	1/4	40	65	135	150	70	130
— 5	5/16	40	80	180	200	85	180
— 6	3/8	75	125	270	300	100	250
— 8	1/2	150	250	450	500	210	420
—10	5/8	200	350	650	700	300	480
—12	3/4	300	500	900	1000	500	850
—16	1	500	700	1200	1400	700	1150
—20	1-1/4	600	900			1080	1440
—24	1-1/2	600	900			1080	1572

TABLE XLII. TORQUE VALUES FOR SELF-LOCKING NUTS

Vendor	Identification	Size	Threads Per inch	Torque (lb in.)
ESNA	70ZN–82 – 1803–82	8	32	20 – 25
ESNA	70ZM–02 – 1803–02	10	32	30 – 45
ESNA	79HA5–0a	10	32	30 – 45
ESNA	79HA34–02	10	32	30 – 45
Boots	B2F1032	10	32	30 – 45
Solar	12352–1032	10	32	30 – 45
	AN363–1032	10	32	30 – 45
	AN365–1032	10	32	30 – 45
ESNA	22A1–048	1/4	28	60 – 95
ESNA	22A17–048	1/4	28	60 – 95
ESNA	22NA17–048	1/4	28	60 – 95
ESNA	42–040TF	1/4	20	50 – 75
ESNA	42E–048	1/4	28	60 – 95
ESNA	52ZA1–048	1/4	28	60 – 95
ESNA	70ZE–048 – 1803–048	1/4	28	60 – 95
ESNA	79HE–048	1/4	28	60 – 95
ESNA	79A1–048	1/4	28	60 – 95
	AN363–428	1/4	28	60 – 95
	AN365–428	1/4	28	60 – 95
ESNA	42E–054	5/16	24	130 – 180
ESNA	79HE–054	5/16	24	130 – 180
ESNA	79HA1–054	5/16	24	130 – 180
	AN363–524	5/16	24	130 – 180
	AN365–524	5/16	24	130 – 180
ESNA	EB–054	5/16	24	130 – 180

TABLE XLII. TORQUE VALUES FOR SELF-LOCKING NUTS (cont)

Vendor	Identification	Size	Threads Per inch	Torque (lb in.)
ESNA	52TE–064	3/8	24	130 – 160
ESNA	52ZE–064 – 1081–064	3/8	24	160 – 240
ESNA	79HE–064	3/8	24	260 – 320
	AN363–624	3/8	24	260 – 320
	AN365–624	3/8	24	260 – 320
	AN363–720	7/16	20	400 – 490
	AN365–720	7/16	20	400 – 490
	AN363–820	1/2	20	744 – 756 (60 – 61 lb ft)
	AN365–820	1/2	20	744 – 756 (60 – 61 lb ft)
	ESNA Z–1000 SERIES SILVER-PLATED			
ESNA	Z1000–048	1/4	28	36 – 70
ESNA	Z1000–054	5/16	24	80 – 130
ESNA	Z1000–064	3/8	24	190 – 230
ESNA	Z1000–074	7/16	20	290 – 360
	ESNA Z–1200 SERIES SILVER-PLATED			
ESNA	Z–1200–02	10	32	20 – 25
ESNA	ZC3–1200–02	10	32	20 – 25
ESNA	ZC4–1200–02	10	32	20 – 25
ESNA	Z1200–048	1/4	28	36 – 70
ESNA	ZA1P–1200–048	1/4	28	36 – 70
ESNA	ZA1W–1200P–048	1/4	28	36 – 70
ESNA	Z–1200–064	3/8	24	190 – 230
ESNA	ZEB–064	3/8	24	160 – 240

TABLE XLIII. TORQUE VALUES FOR STUD BOLTS THREADED INTO ALUMINUM AND MAGNESIUM

NC and 8 Series	Size	Torque (lb in.)
24	10	35
20	1/4	75
18	5/16	135
16	3/8	240
14	7/16	370
13	1/2	560

TABLE XLIV. TORQUE VALUES FOR STEPPED STUDS, NUT END, AND LOCK-THREAD STUDS THREADED INTO ALUMINUM AND MAGNESIUM

NF Series	Size	Minimum Torque (lb in.)
32	10	35
28	1/4	75
24	5/16	135
24	3/8	240
20	7/16	370
20	1/2	560

TABLE XLV. STUD BOLTS IN ALUMINUM AND MAGNESIUM

Dwg. No.	8482407	9902245	9902246	9902247	9493266	8986936	131B560	131B569	131B497	8986935	131B496
"A" Thread Size	1/4–28 NF–2	1/4–28 NF–2	1/4–28 NF–2	1/4–28 NF–2	5/16–24 NF–2	5/16–24 NF–2	5/16–24 NF–2	5/16–24 NF–2	5/16–24 NF–3	3/8–24 NF–3	3/8–24 NF–3
"B" Thread Size	1/4–20	5/16–18	5/16–18	5/16–18	5/16–18	5/16–18	5/16–18	5/16–18	5/16–18	3/8–16	3/8–16
Except PD	NS	NS	NS	NS	NS	NS	NS	NS	NS	NC–3	NC–3
Stud Length "C"	1.8125	2.48	2.16	1.92	1.88	1.687	2.00	2.44	1.687	1.947	1.947

TABLE XLV. STUD BOLTS IN ALUMINUM AND MAGNESIUM (cont)

Dwg. No.	8482407	9902245	9902246	9902247	9493266	8986936	131B560	131B569	131B497	8986935	131B496
"B" Thread PD Limits and Color Coding											
Red											
Min						0.2770	0.2804	0.2804	0.2804	0.3350	0.3384
Max						0.2788	0.2818	0.2818	0.2818	0.3368	0.3398
Violet											
Min	0.2195	0.2785	0.2785	0.2785	0.2785	0.2785	0.2819	0.2819	0.2819	0.3365	0.3399
Max	0.2211	0.2803	0.2803	0.2803	0.2803	0.2803	0.2833	0.2833	0.2833	0.3383	0.3413
Yellow											
Min	0.2212	0.2804	0.2804	0.2804	0.2804	0.2800	0.2834	0.2834	0.2834	0.3380	0.3414
Max	0.2228	0.2818	0.2818	0.2818	0.2818	0.2818	0.2848	0.2848	0.2848	0.3398	0.3428
Brown											
Min	0.2229	0.2819	0.2819	0.2819	0.2819	0.2815	0.2849	0.2849	0.2849	0.3395	0.3429
Max	0.2243	0.2833	0.2833	0.2833	0.2833	0.2833	0.2863	0.2863	0.2863	0.3413	0.3443
Blue											
Min	0.2244	0.2834	0.2834	0.2834	0.2834	0.2830	0.2864	0.2864	0.2864	0.3310	0.3444
Max	0.2258	0.2848	0.2848	0.2848	0.2848	0.2848	0.2878	0.2878	0.2878	0.3428	0.3458
Uncolored											
Min	0.2259	0.2849	0.2849	0.2849	0.2849						*0.3459
Max	0.2273	0.2863	0.2863	0.2863	0.2863						*0.3473
Black											
Min	0.2274	0.2864	0.2864	0.2864	0.2864						
Max	0.2288	0.2878	0.2878	0.2878	0.2878						

*Black on No. 131B496

TABLE XLVI. JAM NUTS FOR FITTINGS USED WITHOUT GASKETS (AN924) Torque (Pound-Inches)

AN Dash No.	Aluminum or Alloy	Steel*
— 2	75	90
— 4	100	150
— 6	135	275
— 8	260	450
— 10	350	600 (50 lb-ft)
— 12	600 (50 lb-ft)	1080 (90 lb-ft)
— 16	900 (75 lb-ft)	1800 (150 lb-ft)
— 20	1080 (90 lb-ft)	
— 24	1320 (110 lb-ft)	

*Only where both the mating threads are steel will steel torque values be used. In all other cases values for aluminum will be used.

TABLE XLVII. SCREW BUSHINGS (THREADED INSERTS)

Dwg No.	8481464	9451245	102A100	9451431	8982874	8982880	102A111	8982838	102A101	102A112
"A" Thread Size	5/16–18 NS	5/16–18 NS	5/16–18 NS	3/8–16 NS	3/8–16 NS	3/8–16 NS	3/8–16 NS	7/16–14 NS	7/16–14 NS	7/16–14 NS
"B" Thread Size	#10–32 NF–2	#10–32 NF–3	#10–32 NF–3	#10–32 NF–2	1/4–28 NF–2	1/4–28 NF–2	1/4–28 NF–3	1/4–28 NF–2	1/4–28 NF–3	5/16–24 NF–3
Bushing Length "C" "A" Thread PD and Color Coding	0.188	0.250	0.375	0.375	0.500	0.250	0.375	0.375	0.438	0.500
Ref No.										
1 Red										
Min	0.2759	0.2759	0.2759	0.3339	0.3339	0.3339	0.3339	0.3906	0.3906	0.3906
Max	0.2772	0.2772	0.2772	0.3353	0.3353	0.3353	0.3353	0.3921	0.3921	0.3921
2 Violet										
Min	0.2769	0.2769	0.2769	0.3350	0.3350	0.3350	0.3350	0.3918	0.3918	0.3918
Max	0.2783	0.2783	0.2783	0.3365	0.3365	0.3365	0.3365	0.3934	0.3934	0.3934
3 Yellow										
Min	0.2780	0.2780	0.2780	0.3362	0.3362	0.3362	0.3362	0.3931	0.3931	0.3931
Max	0.2794	0.2794	0.2794	0.3377	0.3377	0.3377	0.3377	0.3947	0.3947	0.3947
4 Brown										
Min	0.2791	0.2791	0.2791	0.3374	0.3374	0.3374	0.3374	0.3944	0.3944	0.3944
Max	0.2805	0.2805	0.2805	0.3389	0.3389	0.3389	0.3389	0.3960	0.3960	0.3960
5 Blue										
Min	0.2802	0.2802	0.2802	0.3386	0.3386	0.3386	0.3386	0.3957	0.3957	0.3957
Max	0.2813	0.2813	0.2813	0.3398	0.3398	0.3398	0.3398	0.3970	0.3970	0.3970
6 Black										
Min	0.2810	0.2810	0.2810	0.3395	0.3395	0.3395				
Max	0.2821	0.2821	0.2821	0.3410	0.3410	0.3410				

Dwg No.	102A102	9493412	8469814	102A103	8495418	102A104	102A113	102A105
"A" Thread Size	1/2–13 NS	9/16–12 NS	9/16–12 NS	5/8–11 NS	5/8–11 NS	3/4–10 NS	3/4–10 NS	7/8–9 NS
"B" Thread Size	5/16–24 NF–3	5/16–24 NF–2	3/8–24 NF–2	3/8–24 NF–3	3/8–16 NC–2	7/16–20 NF–3	1/2–20 NF–3	1/2–20 NF–3
Bushing Length "C" "A" Thread PD and Color Coding	0.500	0.500	0.500	0.625	0.594	0.688	0.750	0.812
Ref No.								
1 Red								
Min	0.4495	0.5079	0.5079	0.5655	0.5655	0.6845	0.6845	0.8023
Max	0.4510	0.5095	0.5095	0.5672	0.5672	0.6863	0.6863	0.8042
2 Violet								
Min	0.4507	0.5092	0.5092	0.5669	0.5669	0.6860	0.6860	0.8039
Max	0.4523	0.5109	0.5109	0.5687	0.5687	0.6879	0.6879	0.8059
3 Yellow								
Min	0.4520	0.5106	0.5106	0.5684	0.5684	0.6876	0.6876	0.8056
Max	0.4536	0.5123	0.5123	0.5702	0.5702	0.6895	0.6895	0.8076
4 Brown								
Min	0.4533	0.5120	0.5120	0.5699	0.5699	0.6892	0.6892	0.8073
Max	0.4549	0.5137	0.5137	0.5717	0.5717	0.6911	0.6911	0.8093
5 Blue								
Min	0.4546	0.5134	0.5134	0.5714	0.5714	0.6908	0.6908	0.8090
Max	0.4559	0.5148	0.5148	0.5729	0.5729	0.6924	0.6924	0.8107
6 Black								
Min								
Max								

TABLE XLVIII. TORQUE VALUES FOR JAM NUTS USED ON FITTINGS WITH GASKETS

An Dash No.	Straight or Bulkhead Fittings	Raybould Fittings	
		Steel Tubing	Aluminum Tubing
— 4	100 lb in.	45 lb in.	....
— 6	125 lb in.	125 lb in.	....
— 8	200 lb in.	175 lb in.	95 lb in.
—10	275 lb in.	200 lb in.	....
—12	400 lb in.	200 lb in.	....
—16	50 lb ft		
—20	60 lb ft		
—24	75 lb ft		

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1. No. 1 Island Junction Box
2. Main Junction Box
3. Ignition Coil
4. Ignition Coil
5. Compressor Discharge Pressure Sensor
6. Ignition Vibrator
7. Emergency Fuel Regulator
8. Flanged Offset Connector
9. Anti-icing Air Valve
10. Oil Filter
11. Oil Thermal By-pass Valve
12. Oil Cooler
13. Flanged Offset Connector
14. Eighth Stage Air Extraction Pad
15. Ignition Coil
16. Ignition Coil
17. Fuel Flow Divider
18. Twelfth Stage Air Extraction Pad
19. Small Slot Fuel Manifold
20. Large Slot Fuel Manifold
21. Ignitor Plug
22. Ignitor Plug
23. Ignitor Plug
24. Ignitor Plug
25. Fuel Drain Line
26. Compressor Rear Frame Fire Warning Lead
27. Turbine Rotor Cooling Air Line
28. Small Slot Fuel Manifold Connector Tee
29. Large Slot Fuel Manifold Connector Tee
30. Thermocouple Lead
31. Twelfth Stage Air Extraction Pad
32. Screen Actuator Motor
33. Anti-icing Line
34. Oil Pressure Indicator Tee

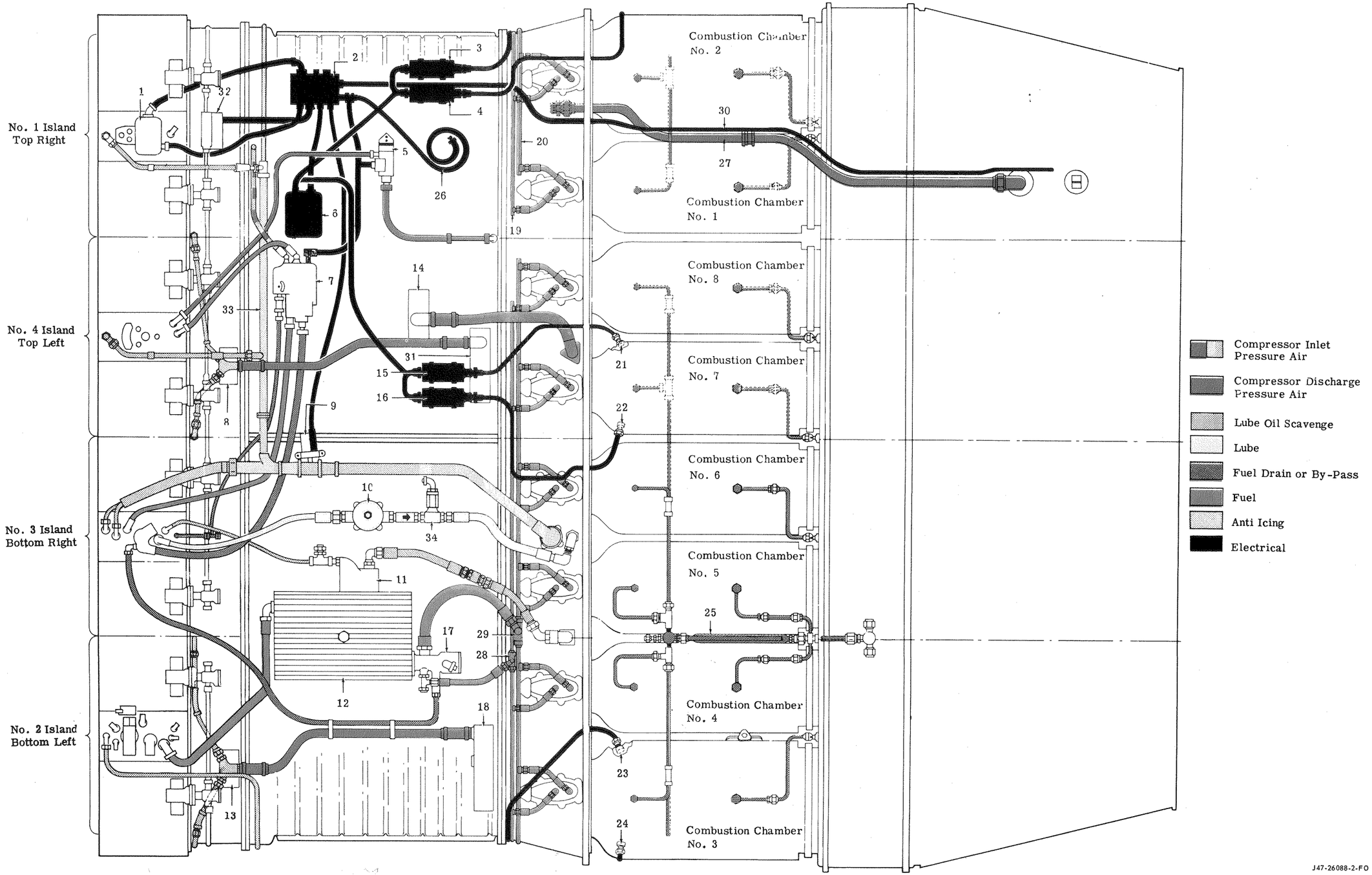


Figure 6-48. External Piping and Wiring on J47-27 Engines

1. Trimmer Valve
2. Main Junction Box
3. Ignition Coil
4. Ignition Coil
5. Air Metering Orifice
6. Ignition Vibrator
7. Sensing Bleed Valve Solenoid
8. Flanged Offset Connector
9. Anti-icing Air Valve
10. Oil Filter
11. Oil Thermal By-pass Valve
12. Oil Cooler
13. Flanged Offset Connector
14. Eighth Stage Air Extraction Pad
15. Ignition Coil
16. Ignition Coil
17. Fuel Flow Divider
18. Twelfth Stage Air Extraction Pad
19. Small Slot Fuel Manifold
20. Large Slot Fuel Manifold
21. Ignitor Plug
22. Ignitor Plug
23. Ignitor Plug
24. Ignitor Plug
25. Fuel Drain Line
26. Accumulator Cowl Guide
27. Turbine Rotor Cooling Air Line
28. Large Slot Fuel Manifold Connector Tee
29. Small Slot Fuel Manifold Connector Tee
30. Thermocouple Lead
31. Twelfth Stage Air Extraction Pad
32. Water-Alcohol Injection Manifold
33. Anti-icing Line
34. Oil Pressure Indicator Tee
35. Water-Alcohol Injection Check Valve

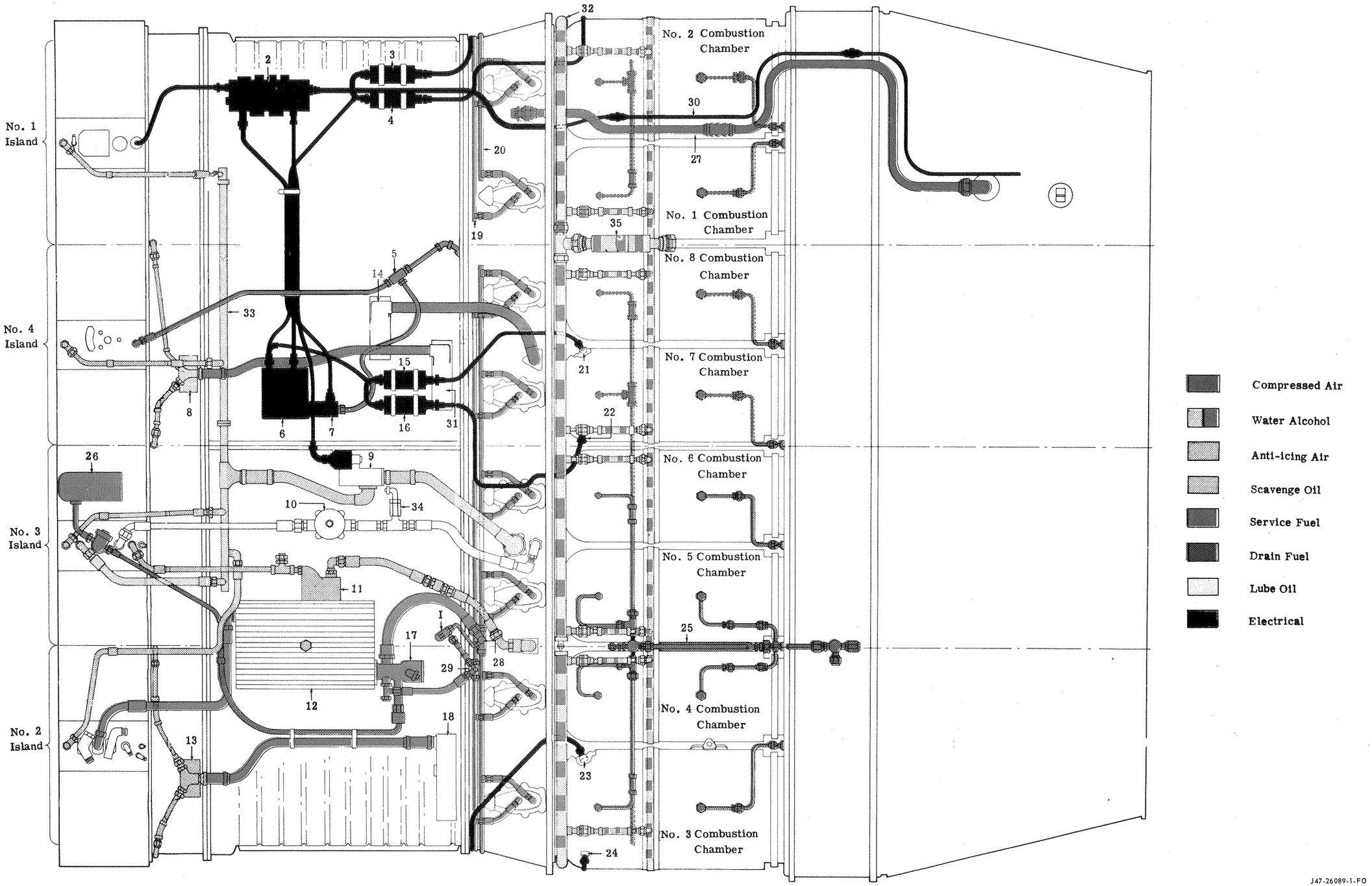


Figure 6-49. External Piping and Wiring on J47-23, -25 and -25A Engines

1. No. 2 Bearing Cover
2. No. 2 Bearing Cover Gasket
3. No. 2 Bearing Cap
4. Gasket
5. No. 2 Bearing Housing
6. Twelfth Stage Inner Air Seal
7. Twelfth Stage Outer Air Seal
8. Twelfth Stage Vent Screen
9. Twelfth Stage Vent Screen
10. Compressor Rear Frame
11. Oil Drain Plug
12. Manifold Take-Off Cover
13. Transfer Tube (Large)
14. Transfer Tube (Small)
15. Compressor Shaft No. 2 Bearing Oil Deflector
16. No. 2 Bearing
17. No. 2 Bearing Gasket
18. Spacer
19. Oil Shield Assembly
20. "O" Ring Seal
21. No. 2 Bearing Retaining Ring
22. Scavenge Pump Gear Train Assembly

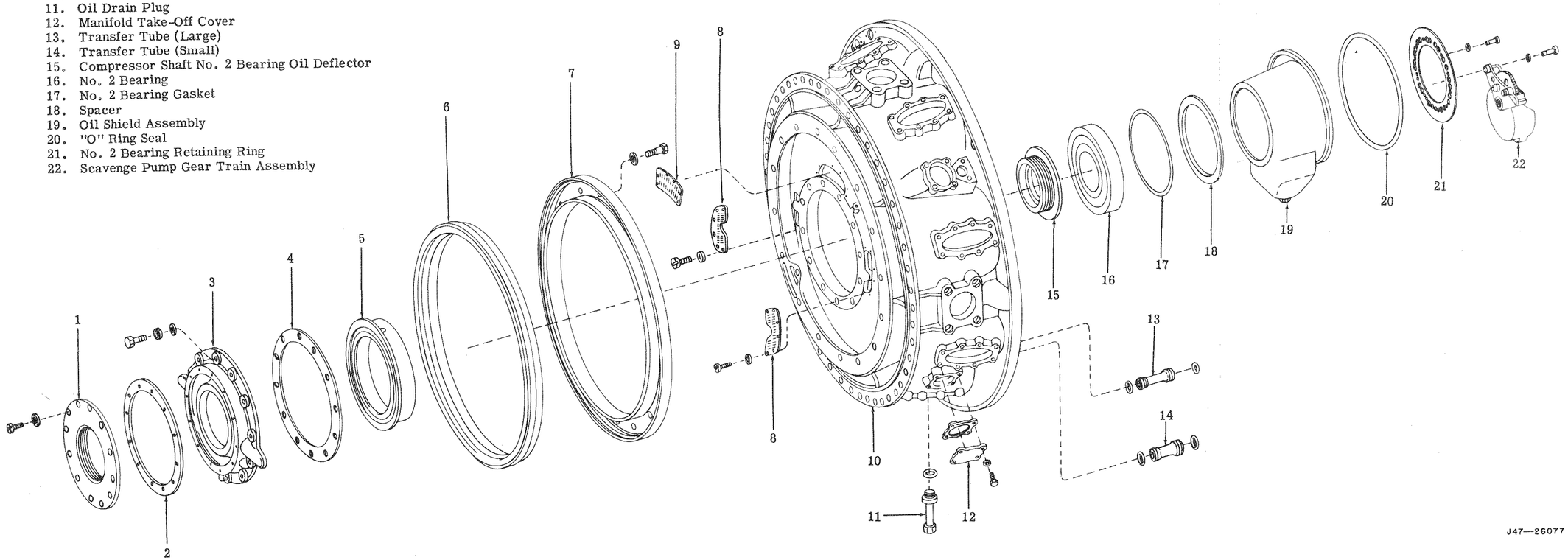
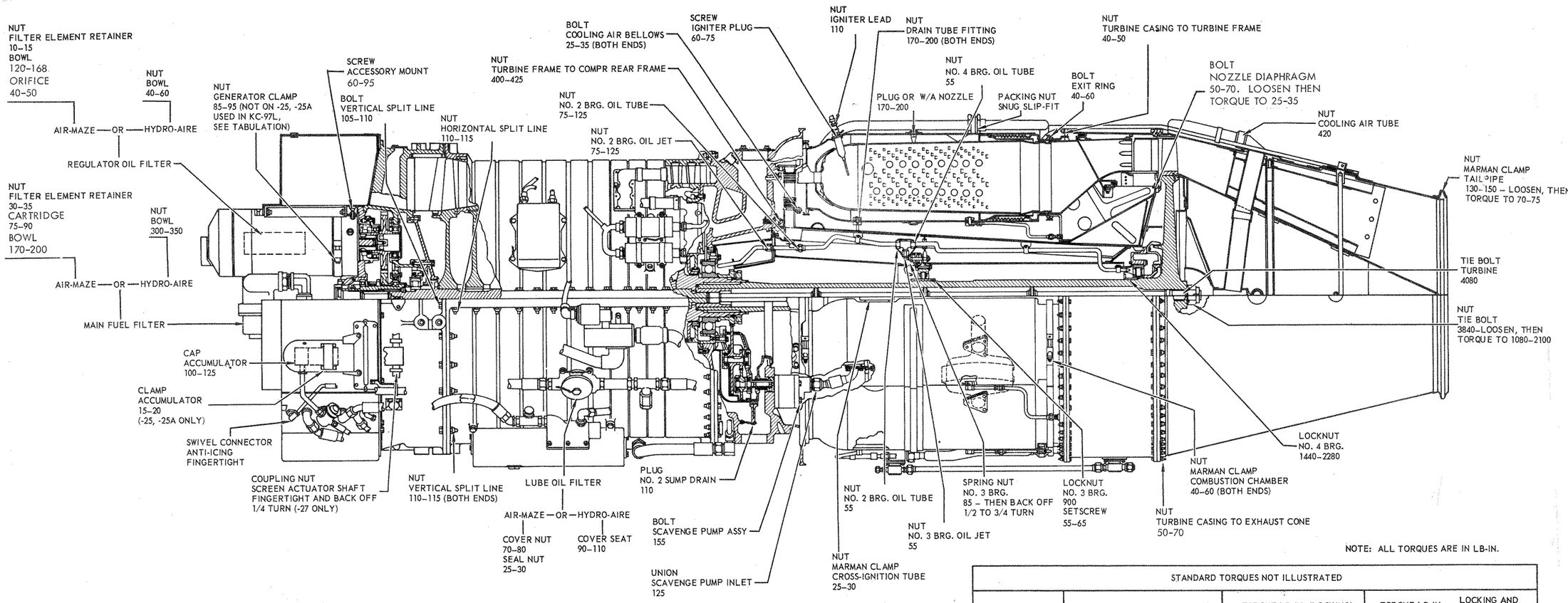


Figure 5–51. Exploded View Compressor Rear Frame



NOTE: ALL TORQUES ARE IN LB-IN.

FRONT FRAME COMPONENTS	
NAME	TORQUE LB-IN.
MAGNETIC DRAIN PLUG	40–60
RELIEF VALVE	200–250
CHECK VALVE	200–250
STARTER–GENERATOR LEAD BOLT	100–105
JACK & HEINTZ STARTER JAW BOLT (KC-97L)	160–190
JACK & HEINTZ STARTER MOUNTING NUT (KC-97L)	260–320

SPECIAL TORQUES NOT ILLUSTRATED	
NAME	TORQUE LB-IN.
ELBOWS AND HOSES–LARGE-SLOT FUEL NOZZLE PORT	200
ELBOWS AND HOSES–SMALL-SLOT FUEL NOZZLE PORT	100
ELECTRICAL LEAD–PIN-TYPE CONNECTORS	FINGERTIGHT

STANDARD TORQUES NOT ILLUSTRATED			
THREAD SIZE	TORQUE LB-IN. (NON-LOCKING)	TORQUE LB-IN. (LOCKING)	TORQUE LB-IN. LOCKING AND SILVER-PLATED
8–32	13–16	20–25	———
10–32	24–27	30–45	20–25
0.250-20	30–60	50–75	———
0.250-28	36–70	60–95	36–70
0.3125-24	80–130	130–180	80–130
0.375-24	190–230	260–320	190–320
0.4375-20	290–360	400–490	290–360
0.500-20	480–570	744–756	———

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Figure 8-12A. Torque Chart

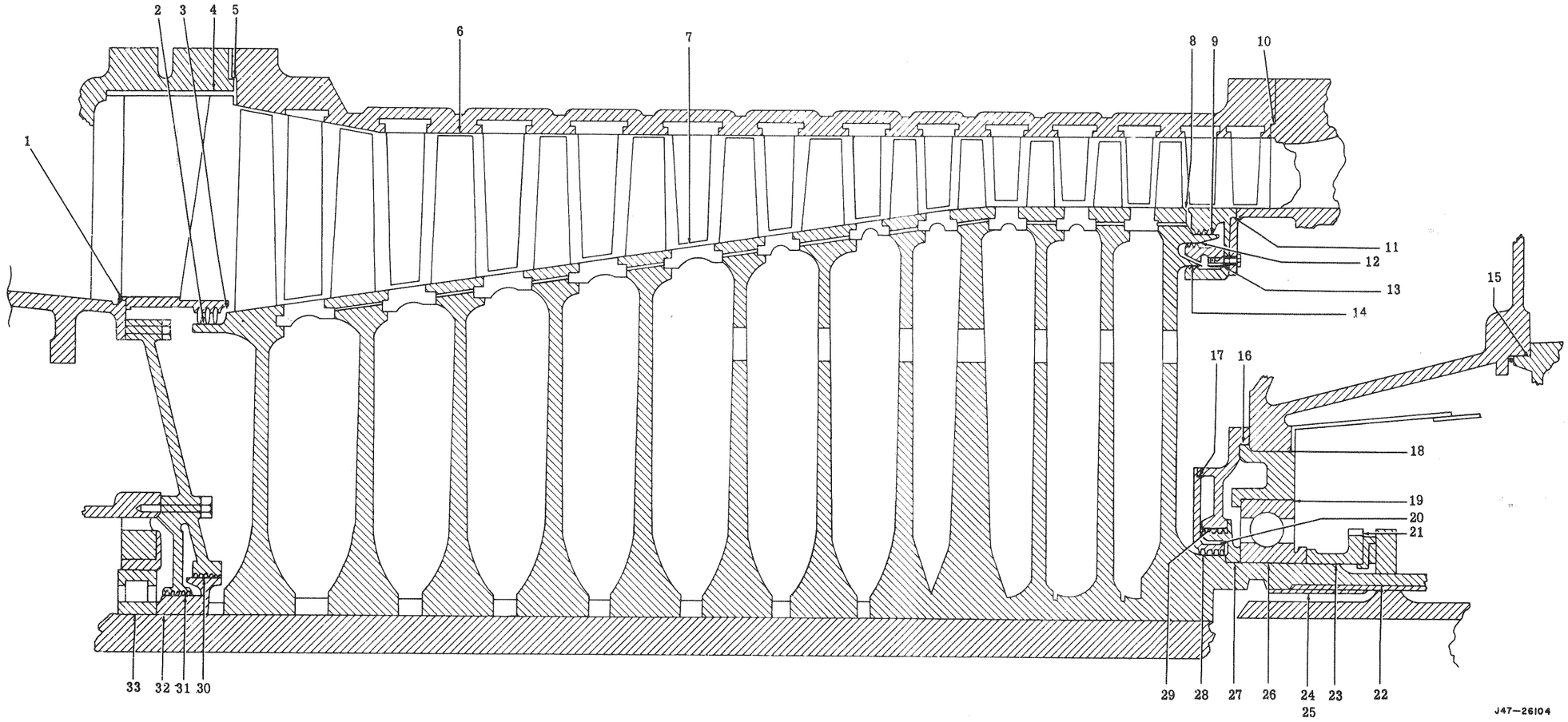

Figure 8-1. Compressor Section Limits

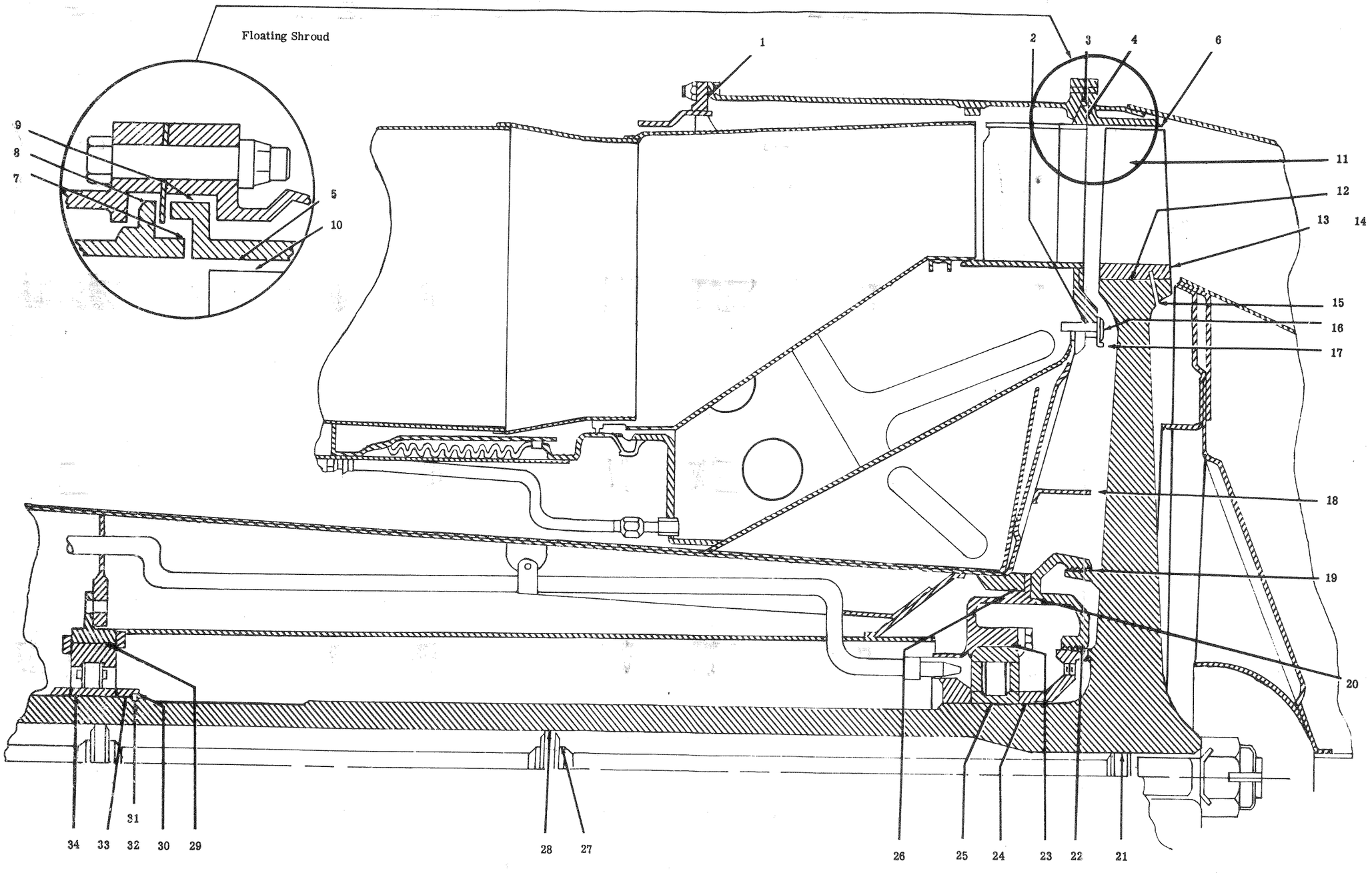

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Figure 8–2. Turbine Section Limits

1. Splined Adapter
2. Locking Disc
3. Spanner Nut
4. "O" Ring
5. Seal Assembly (Carbon)
6. Seal
7. Ring Seal
8. Snap Ring
9. Seal Retaining Ring
10. Seal Assembly
11. "O" Ring
12. Lube Pressure Relief Valve
13. "O" Ring
14. "O" Ring
15. Screen Assembly
16. Inner Coupling
17. Cap Assembly
18. "O" Ring
19. "O" Ring
20. Seal Assembly (Carbon)
21. Seal
22. Ring Seal
23. Snap Ring
24. Seal Retaining Ring
25. Seal Assembly
26. "O" Ring
27. Snap Ring
28. Seal Retaining Ring
29. Seal Assembly
30. "O" Ring
31. Lube Check Valve
32. "O" Ring
33. "O" Ring
34. Gasket
35. Bleeder Seal
36. Front Cover
37. Ring Seal
38. Lube Oil Tube Assembly
39. Snap Ring
40. Starter-Generator Front Bearing
41. Bearing Housing
42. Snap Ring
43. Snap Ring
44. Bearing
45. Bearing Housing
46. Tab Washer
47. Spanner Nut
48. Bearing Assembly (Inner Race; Outer Race and Rollers)
49. Spacer
50. "O" Ring
51. Bearing Housing
52. Snap Ring
53. Snap Ring
54. Bearing
55. Bearing Housing
56. Snap Ring
57. Snap Ring
58. Bearing
59. Bearing Housing
60. Lube Pump Outlet Tube Assembly
61. Starter-Generator Gear
62. Main Fuel Regulator Gear
62. Fuel Regulator Drive Gear
6-. Lube Pump Drive Gear
65. Starter-Generator Drive Gear
66. Accessory Drive Shaft
67. Hydraulic Pump Gear
68. Main Fuel Pump Gear
69. Lube Pump Shaft Gear
70. Bearing Cap
71. Bearing Outer Race
72. Starter Gear Rear Bearing Housing
73. Oil Tube
74. Bearing Cap
75. Bearing Assembly (Outer Race; Inner Race and Rollers)
76. Rear Bearing Housing
77. Bearing Housing
78. Bearing
79. Tab Washer
80. Spanner Nut
81. "O" Ring
82. Bearing Cap
83. Bearing Assembly (Outer Race; Inner Race and Rollers)
84. Rear Bearing Housing
85. Bearing Cap
86. Bearing Assembly (Outer Race; Inner Race and Rollers)
87. Rear Bearing Housing
88. Cap
89. Bearing
90. Spacer
91. Bearing Housing
92. Bearing
93. Tab Washer
94. Spanner Nut
95. Oil Shield Cover
96. Lube Oil Scoop
97. Oil Shield Assembly
98. Magnetic Drain Plug Gasket
99. Magnetic Drain Plug
100. Compressor Front Frame
101. Nozzle Assembly
102. Retaining Lug
103. No. 1 Bearing Housing
104. No. 1 Bearing Assembly (Outer Race and Rollers; Inner Race)
105. Retaining Lugs
106. Gasket
107. Gasket
108. Air and Oil Seal
109. Outer Coupling

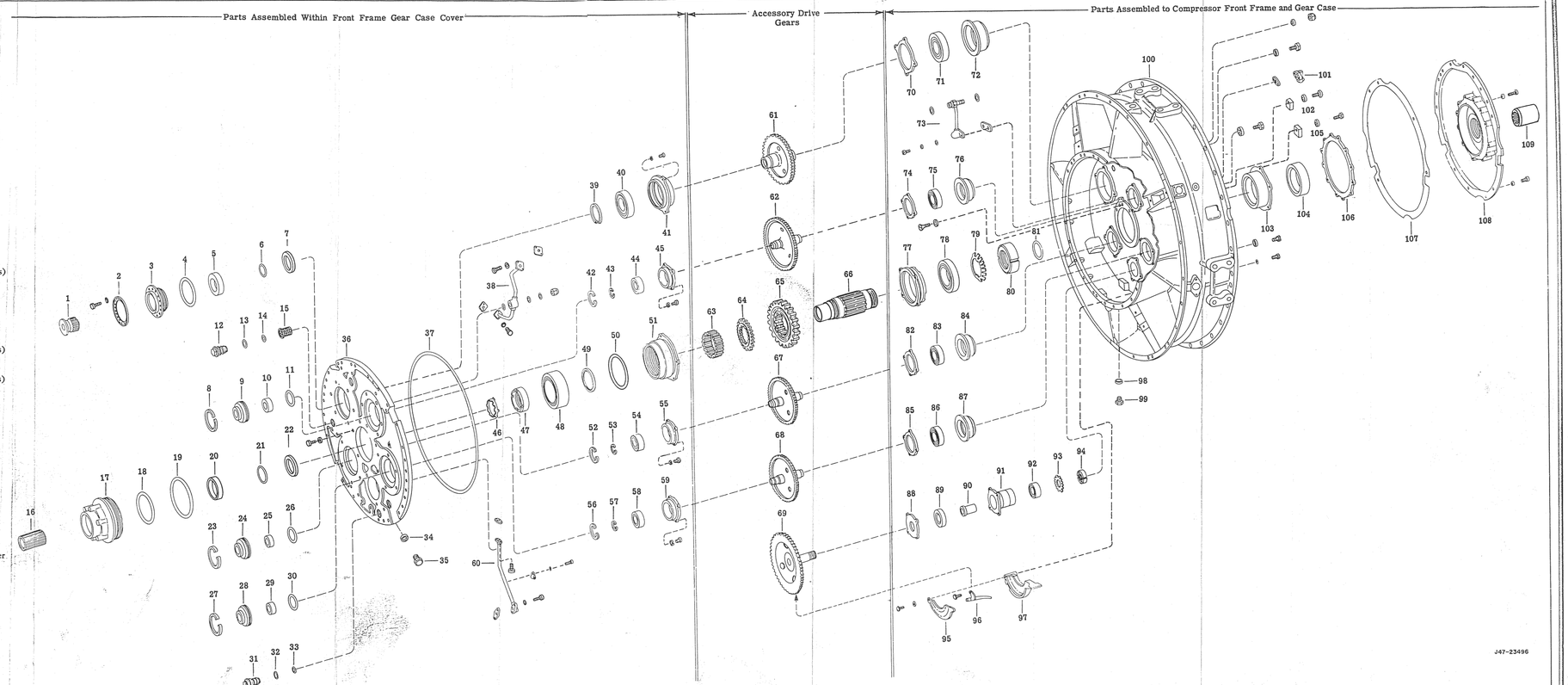

Parts Assembled Within Front Frame Gear Case Cover
Accessory Drive Gears
Parts Assembled to Compressor Front Frame and Gear Case
J47-23496

Figure 6–22. Compressor Front Frame Gearcase

B. For greater flexibility, aircraft wire MIL–W–5274 is recommended for direct connection to engine junction box and engine mounted components. Test cell wire may be rubber or thermoplastic insulated conductor wire, sizes should not be smaller than AWG Nr 16, other sizes as noted.

b. Wiring schematic, Figure 7–7 applicable to the –27 model engine.

(1) Tachometer panel, same as Item Nr (10), Para. 7–59a.

(2) Compressor air inlet screen switch, same as Item Nr (1), Para. 7–59a.

(3) Anti-icing air switch, same as Item Nr (2), Para. 7–59a.

(4) Fuel system selector switch, (MAIN-EMERG-ALERTED-EMERG) Type MS 35058–5.

(5) Ignition switch (ON-OFF), Type MS 35058–1.

(6) Start switch, same as Item (4), Para. 7–59a.

(7) Emergency stop switch, same as Item (5), Para. 7–59a.

(8) Ignition test switch, same as Item (6), Para. 7–59a.

(9) Ignition relay, same as Item (7), Para. 7–59a.

(10) Shunt field relay, same as Item (8), Para. 7–59a.

7–60. ENGINE PREPARATION PRIOR TO TEST.

7–61. GENERAL. The following are general procedural steps which are required during preparation of engine for test. Subject engine may, at the option of the testing agency, be tested with or without the power take-off assembly installed.

7–62. SLAVE STARTER INSTALLATION. Install slave starter-generator in accordance with instructions contained in Section VI, this technical order.

CAUTION

Exercise care in handling the starter, as unit weighs approximately 75 pounds.

Note

The test cell starter-generator electrical leads are identical to correspond with correct starter-generator terminals by block letters, A, B, C, and E. (Refer to applicable Figure 7–6 or 7–7.)

7–63. ENGINE LIFTING TOOL. Install lifting eye, 1C981 or equivalent, to the top compressor rear frame mounting pad. Do not overtorque.

7–64. ENGINE MOUNT INSTALLATION. Install the following engine mount adapters.

a. Install left and right test dolly trunnion mounts to the engine compressor rear frame right and left mounting pads. Torque bolts to 480-570 pound-inches and safety.

7–65. ENGINE INSTALLATION IN TEST DOLLY. Due to variations in design of the different dollies, precise installation instructions cannot be included in this technical order. In general, apply the following procedures:

a. Attach hoist to lifting eye so that the point of suspension is approximately at the engine center of gravity.

b. Raise hoist and install engine in the appropriate test dolly.

CAUTION

Exercise care to prevent the engine from swinging in order to avoid possible damage to engine and injury to personnel.

c. Install right and left trunnion mount retaining caps, torque and safety wire.

d. Secure forward steady support mount to test dolly and engine forward mount.

7–66. TAILCONE INSTALLATION. (Refer to Section VI, this technical order for specific instructions.)

7–67. TAILPIPE INSTALLATION. Install tailpipe as follows:

a. Prior to installation, inspect pipe and thermocouples for proper condition; then raise into position.

b. place clamp over exhaust cone and tailpipe flanges; place the clamp splits in the horizontal positions.

c. Torque clamp bolt to 130-150 inch pounds; then loosen and retorque to 70-75 inch pounds and safety wire.

CAUTION

Do not retorque clamp bolts after engine has been operated. Normally, the torque will fall below the 70-75 inch pounds after engine operation. However, the clamp will tighten sufficiently to provide a satisfactory joint during engine operation because of differential thermo expansion of the clamp and the exhaust piping.

7–68. JET NOZZLE INSTALLATION. Inspect and install the jet exhaust nozzle in the same manner as the tailpipe assembly.

7–69. EXHAUST PIPING INSPECTION. With the exhaust piping completely installed and properly torqued, check the following:

a. The clamp "V" band gap clearance on each side shall not be less than 1/8 inch.

b. At least three threads must show through the clamp nuts.

Note

If the "V" band gap is less than 1/8 inch, excessive circumferential stretch is indicated; therefore, clamp shall not be used during test.

7–70. MISCELLANEOUS EQUIPMENT INSTALLATION. Install the necessary slave adapters, fittings and

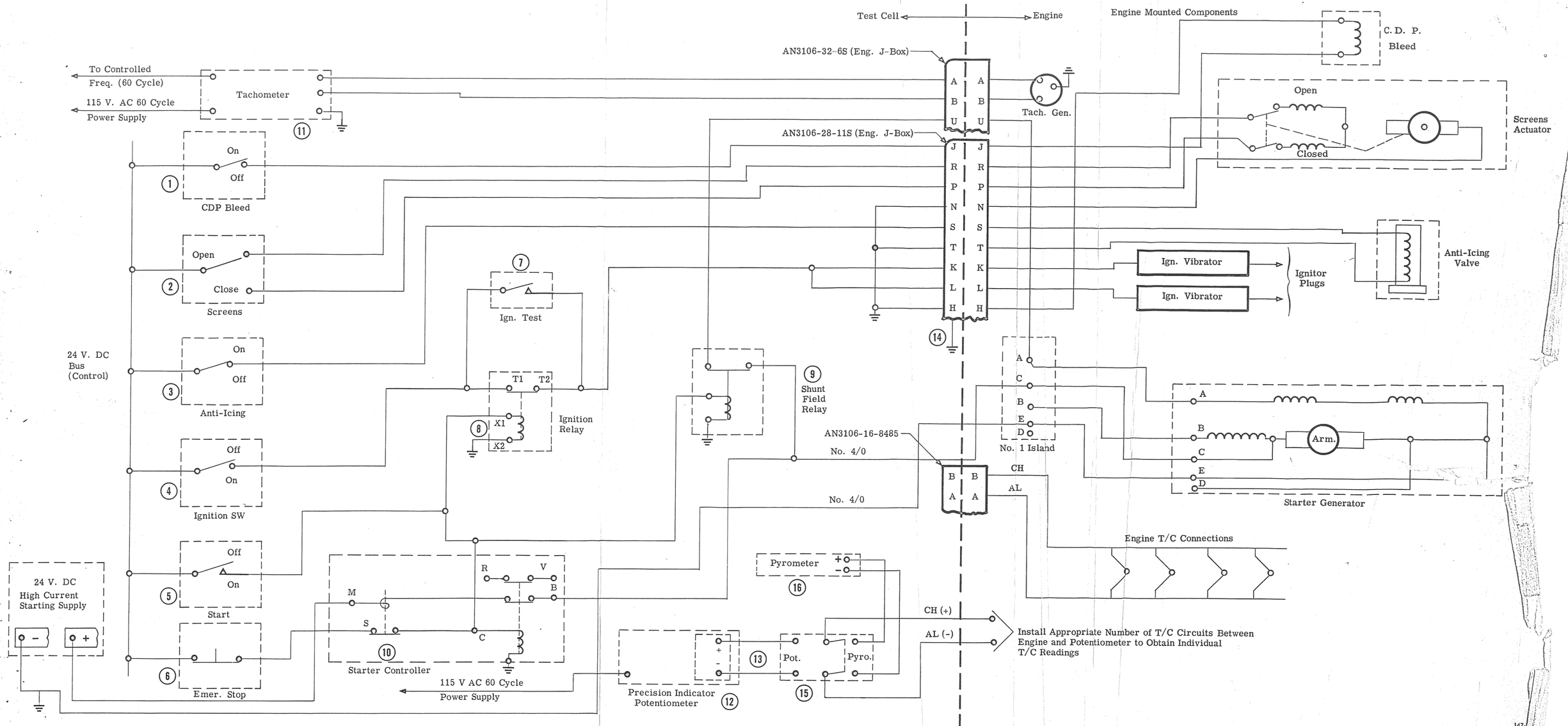


Figure 7-6. Wiring Schematic (-23, -25)

1. Bracket
2. Forward Oil Shield Assembly
3. Cotter Pins
4. Nut
5. Washer
6. Guide
7. Ring Assembly
8. Springs
9. Guide
10. Bearing Outer Race and Roller Assembly
11. Bearing Housing
12. Stud
13. Nut
14. Rear Oil Shield Assembly
15. No. 2 Bearing Oil Jet
16. Tube Assembly
17. Clip Assembly
18. Nut
19. Packing
20. Lube Oil Tee
21. Damper Bearing Oil Jet
22. Packing
23. Nut
24. Turbine Frame
25. Gasket
26. Eighth Stage Cooling Air Bellows
27. Gasket
28. Turbine Frame Breather
29. Anchor Nut Plates
30. No. 4 Bearing Housing
31. Transition Lines
32. Clamp
33. No. 4 Bearing Oil Jet Bracket
34. No. 4 Bearing Outer Race
35. Grommet
36. Retainer Ring
37. No. 4 Bearing Lube Oil Tube Assembly
38. Clamp
39. Gasket
40. Seal Assembly
41. Turbine Casing Assembly
42. Turbine Nozzle
43. Air Deflectors
44. Gasket
45. Connector Tee
46. Outer Band
47. Inner Band
48. Transition Liners
49. Tube Cover
50. Gasket
51. Cap
52. Pins (Transition Liner)

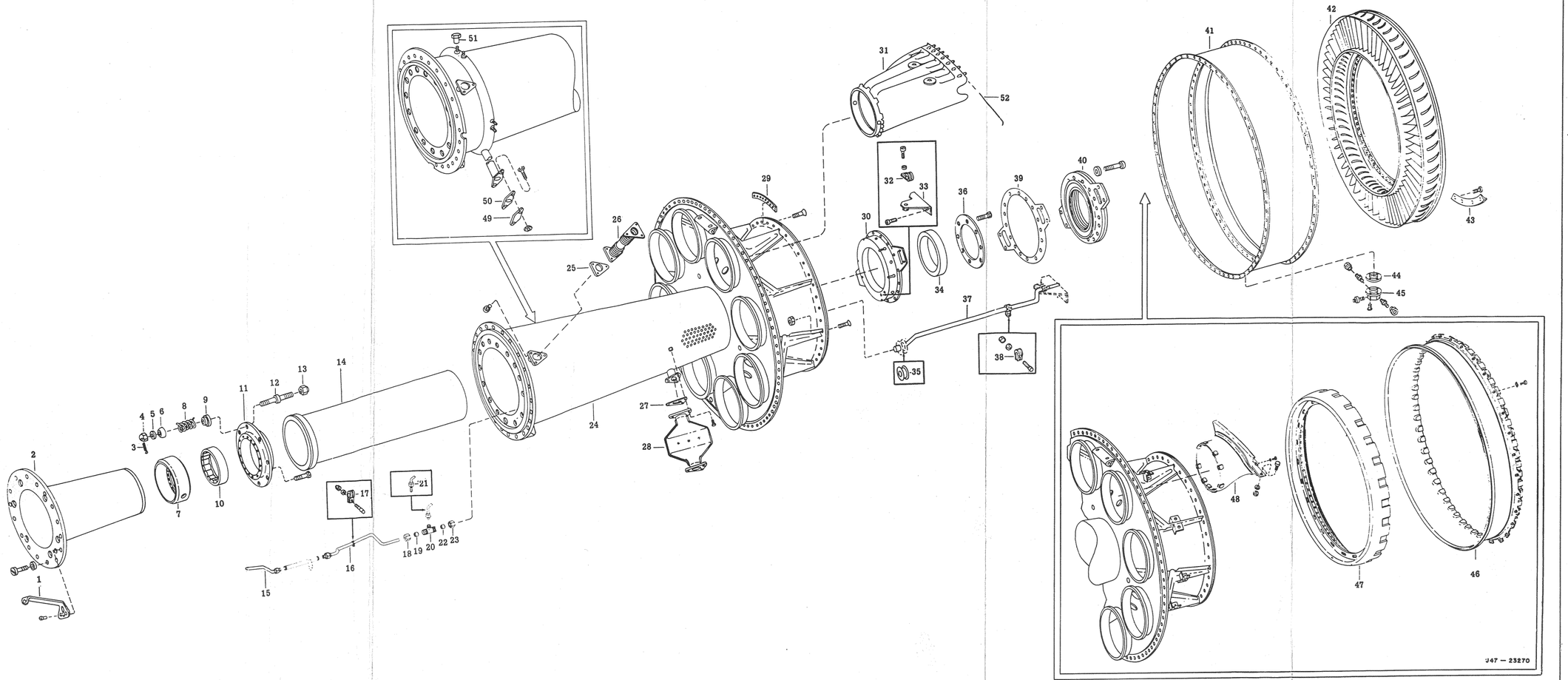


Figure 5–78. Exploded View Turbine Frame

MODEL

J47-GE-25 J47-GE-27

7953 RPM

CHART CALCULATED FOR RAM DIFFERENTIAL PRESSURE O INCH H_2O

MAXIMUM ALLOWABLE EXHAUST GAS TEMPERATURE 690°C (1275°F)

VAPOR PRESSURE CORRECTION CHART

VAPOR PRESS. ("HG)	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	1.1	1.2
THRUST CORR. (SUBT)	2	4	6	8	10	12	14	16	18	20	22	24
SFC CORR. (ADD)	.002	.003	.004	.006	.007	.009	.010	.012	.014	.015	.016	.018
EGT CORR. (SUBT)	1	1	1	2	2	3	3	4	4	5	5	6

MINIMUM ALLOWABLE THRUST - POUNDS
COMPRESSOR INLET PRESSURE - INCHES HG ABSOLUTE

COMP. INLET TEMP. °F	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	26.0	26.1	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9	27.0	27.1	27.2	27.3	27.4
18	5440	5462	5484	5506	5527	5549	5571	5593	5614	5636	5658	5680	5701	5723	5745	5767	5788	5810	5832	5853	5875	5897	5919	5940	5962
19	5430	5452	5474	5495	5517	5539	5561	5582	5604	5626	5647	5669	5691	5712	5734	5756	5778	5799	5821	5843	5864	5886	5908	5930	5951
20	5420	5442	5464	5485	5507	5529	5550	5572	5594	5615	5637	5659	5680	5702	5724	5745	5767	5789	5810	5832	5854	5875	5897	5919	5940
21	5410	5432	5454	5475	5497	5518	5540	5562	5583	5605	5627	5648	5670	5691	5713	5735	5756	5778	5800	5821	5843	5864	5886	5908	5929
22	5401	5423	5444	5466	5487	5509	5531	5552	5574	5595	5617	5639	5660	5682	5703	5725	5747	5768	5790	5811	5833	5854	5876	5898	5919
23	5391	5413	5434	5456	5477	5499	5520	5542	5563	5585	5607	5628	5650	5671	5693	5714	5736	5757	5779	5800	5822	5844	5865	5887	5908
24	5381	5403	5424	5446	5467	5489	5510	5532	5553	5575	5596	5618	5639	5661	5682	5704	5725	5747	5768	5790	5811	5833	5854	5876	5897
25	5371	5392	5414	5435	5457	5478	5500	5521	5543	5564	5586	5607	5629	5650	5672	5693	5715	5736	5757	5779	5800	5822	5843	5865	5886
26	5360	5382	5403	5424	5446	5467	5489	5510	5532	5553	5574	5596	5617	5639	5660	5681	5703	5724	5746	5767	5789	5810	5831	5853	5874
27	5349	5371	5392	5413	5435	5456	5478	5499	5520	5542	5563	5585	5606	5627	5649	5670	5691	5713	5734	5756	5777	5798	5820	5841	5862
28	5338	5360	5381	5402	5424	5445	5466	5488	5509	5530	5552	5573	5594	5616	5637	5658	5680	5701	5723	5744	5765	5787	5808	5829	5851
29	5328	5349	5370	5391	5413	5434	5455	5477	5498	5519	5540	5562	5583	5604	5626	5647	5668	5690	5711	5732	5753	5775	5796	5817	5839
30	5317	5338	5359	5380	5402	5423	5444	5465	5487	5508	5529	5550	5572	5593	5614	5635	5657	5678	5699	5720	5742	5763	5784	5805	5827
31	5306	5327	5348	5369	5391	5412	5433	5454	5475	5497	5518	5539	5560	5582	5603	5624	5645	5666	5688	5709	5730	5751	5772	5794	5815
32	5295	5316	5337	5358	5380	5401	5422	5443	5464	5485	5507	5528	5549	5570	5591	5612	5634	5655	5676	5697	5718	5739	5761	5782	5803
33	5284	5305	5326	5347	5369	5390	5411	5432	5453	5474	5495	5516	5538	5559	5580	5601	5622	5643	5664	5685	5707	5728	5749	5770	5791
34	5273	5294	5315	5336	5358	5379	5400	5421	5442	5463	5484	5505	5526	5547	5568	5589	5610	5632	5653	5674	5695	5716	5737	5758	5779
35	5262	5283	5304	5326	5347	5368	5389	5410	5431	5452	5473	5494	5515	5536	5557	5578	5599	5620	5641	5662	5683	5704	5725	5746	5767
36	5251	5272	5293	5314	5335	5356	5377	5398	5419	5440	5461	5482	5503	5524	5545	5566	5587	5608	5629	5650	5671	5692	5713	5734	5755
37	5241	5262	5282	5303	5324	5345	5366	5387	5408	5429	5450	5471	5492	5513	5534	5555	5576	5597	5618	5639	5660	5681	5701	5722	5743
38	5231	5252	5272	5293	5314	5335	5356	5377	5398	5419	5440	5461	5481	5502	5523	5544	5565	5586	5607	5628	5649	5670	5691	5711	5732
39	5220	5241	5261	5282	5303	5324	5345	5366	5387	5407	5428	5449	5470	5491	5512	5533	5554	5574	5595	5616	5637	5658	5679	5700	5720
40	5209	5230	5251	5271	5292	5313	5334	5355	5375	5396	5417	5438	5459	5480	5500	5521	5542	5563	5584	5605	5625	5646	5667	5688	5709
41	5198	5219	5240	5260	5281	5302	5223	5343	5364	5385	5406	5427	5447	5468	5489	5510	5530	5551	5572	5593	5614	5634	5655	5676	5697
42	5187	5208	5229	5249	5270	5291	5312	5332	5353	5374	5395	5415	5436	5457	5477	5498	5519	5540	5560	5581	5602	5623	5643	5664	5685
43	5176	5197	5218	5238	5259	5280	5300	5321	5342	5363	5383	5404	5425	5445	5466	5487	5507	5528	5549	5569	5590	5611	5632	5652	5673
44	5165	5186	5207	5227	5248	5269	5289	5310	5331	5351	5372	5393	5413	5434	5454	5475	5496	5516	5537	5558	5578	5599	5620	5640	5661
45	5155	5175	5196	5216	5237	5258	5278	5299	5319	5340	5361	5381	5402	5422	5443	5464	5484	5505	5525	5546	5567	5587	5608	5628	5649
46	5143	5163	5184	5205	5225	5246	5266	5287	5307	5328	5348	5369	5390	5410	5431	5451	5472	5492	5513	5534	5554	5575	5595	5616	5636
47	5131	5152	5172	5193	5213	5234	5254	5275	5295	5316	5336	5357	5377	5398	5418	5439	5459	5480	5500	5521	5541	5562	5582	5603	5623
48	5119	5140	5160	5181	5201	5222	5242	5263	5283	5304	5324	5345	5365	5386	5406	5426	5447	5467	5488	5508	5529	5549	5570	5590	5611
49	5108	5128	5149	5169	5189	5210	5230	5251	5271	5292	5312	5332	5353	5373	5394	5414	5434	5455	5475	5496	5516	5537	5557	5577	5598
50	5096	5116	5137	5157	5178	5198	5218	5239	5259	5279	5300	5320	5341	5361	5381	5402	5422	5442	5463	5483	5504	5524	5544	5565	5585
51	5084	5105	5125	5145	5166	5186	5206	5227	5247	5267	5288	5308	5328	5349	5369	5389	5410	5430	5450	5471	5491	5511	5532	5552	5572
52	5073	5093	5113	5134	5154	5174	5194	5215	5235	5255	5275	5296	5316	5336	5357	5377	5397	5417	5438	5458	5478	5499	5519	5539	5559
53	5062	5082	5102	5123	5143	5163	5183	5203	5224	5244	5264	5284	5305	5325	5345	5365	5386	5406	5426	5446	5466	5487	5507	5527	5547
54	5050	5070	5090	5111	5131	5151	5171	5191	5212	5232	5252	5272	5292	5313	5333	5353	5373	5393	5413	5434	5454	5474	5494	5514	5535
55	5038	5059	5077	5099	5119	5139	5159	5179	5200	5220	5240	5260	5280	5300	5320	5341	5361	5381	5401	5421	5441	5461	5481	5502	5522

COMP. INLET TEMP. °F	27.5	27.6	27.7	27.8	27.9	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.9
18	5983	6006	6027	6049	6071	6093	6114	6136	6158	6180	6201	6223	6245	6267	6288	6310	6332	6354	6375	6397	6419	6441	6462	6484	6506
19	5973	5995	6016	6038	6060	6082	6103	6125	6147	6168	6190	6212	6233	6255	6277	6299	6320	6342	6364	6385	6407	6429	6451	6472	6494
20	5962	5984	6005	6027	6049	6070	6092	6114	6135	6157	6179	6200	6222	6244	6265	6287	6309	6330	6352	6374	6395	6417	6439	6460	6482
21	5951	5973	5994	6016	6037	6059	6081	6102	6124	6146	6167	6189	6210	6232	6254	6275	6297	6319	6340	6362	6384	6405	6427	6448	6470
22	5941	5962	5984	6006	6027	6049	6070	6092	6114	6135	6157	6178	6200	6222	6243	6265	6286	6308	6329	6351	6373	6394	6416	6437	6459
23	5930	5951	5973	5994	6016	6038	6059	6081	6102	6124	6145	6167	6188	6210	6231	6253	6275	6296	6318	6339	6361	6382	6404	6425	6447
24	5919	5940	5962	5983	6005	6026	6048	6069	6091	6112	6134	6155	6177	6198	6220	6241	6263	6284	6306	6327	6349	6370	6392	6413	6435
25	5908	5929	5951	5972	5994	6015	6037	6058	6080	6101	6122	6144	6165	6187	6208	6230	6251	6273	6294	6316	6337	6359	6380	6402	6423
26	5896	5917	5939	5960	5981	6003	6024	6046	6067	6089	6110	6131	6153	6174	6196	6217	6239	6260	6281	6303	6324	6346	6367	6389	6410
27	5884	5905	5927	5948	5969	5991	6012	6034	6055	6076	6098	6119	6140	6162	6183	6205	6226	6247	6269	6290	6312	6333	6354	6376	6397
28	5872	5893	5915	5936	5957	5979	6000	6021	6043	6064	6085	6107	6128	6149	6171	6192	6213	6235	6256	6277	6299	6320	6341	6363	6384
29	5860	5881	5902	5924	5945	5966	5988	6009	6030	6052	6073	6094	6115	6137	6158	6179	6201	6222	6243	6265	6286	6307	6328	6350	6371
30	5848	5869	5891	5912	5933	5954	5976	5997	6018	6039	6061	6082	6103	6124	6146	6167	6188	6209	6231	6252	6273	6294	6316	6337	6358
31	5836	5857	5878	5900	5921	5942	5963	5984	6006	6027	6045	6069	6091	6112	6133	6154	6175	6197	6218	6239	6260	6281	6303	6324	6345
32	5824	5845	5866	5888	5909	5930	5951	5972	5993	6015	6036	6057	6078	6099	6120	6142	6163	6184	6205	6226	6247	6269	6290	6311	6332
33	5812	5833	5854	5876	5897	5918	5939	5960	5981	6002	6023	6044	6066	6087	6108	6129	6150	6171	6192	6213	6235	6256	6277	6298	6319
34	5800	5821	5842	5863	5884	5906	5927	5948	5969	5990	6011	6032	6053	6074	6095	6116	6137	6159	6180	6201	6222	6243	6264	6285	6306
35	5788	5809	5830	5851	5872	5893	5914	5936	5957	5978	5999	6020	6041	6062	6083	6104	6125	6146	6167	6188	6209	6230	6251	6272	6293
36	5776	5797	5818	5839	5860	5881	5902	5923	5944	5965	5986	6007	6028	6049	6070	6091	6112	6133	6154	6175	6196	6217	6238	6259	6280
37	5764	5785	5806	5827	5848	5869	5890	5911	5932	5953	5974	5995	6016	6037	6058	6079	6099	6120	6141	6162	6183	6204	6225	6246	6267
38	5753	5774	5795	5816	5837	5858	5879	5900	5921	5941	5962	5983	6004	6025	6046	6067	6088	6109	6130	6151	6171	6192	6213	6234	6255
39	5741	5762	5783	5804	5825	5846	5867	5887	5908	5929	5950	5971	5992	6013	6033	6054	6075	6096	6117	6138	6159	6179	6200	6221	6242
40	5729	5750	5771	5792	5813	5834	5854	5875	5896	5917	5938	5958	5979	6000	6021	6042	6063	6083	6104	6125	6146	6167	6188	6208	6229
41	5717	5738	5759	5780	5801	5821	5842	5863	5884	5904	5925	5946	5967	5988	6008	6029	6050	6071	6091	6112	6133	6154	6175	6195	6216
42	5706	5727	5747	5768	5789	5809	5830	5851	5871	5892	5913	5934	5954	5975	5996	6017	6037	6058	6079	6100	6120	6141	6162	6182	6203
43	5694	5714	5735	5756	5776	5797	5818	5838	5859	5880	5900	5921	5942	5963	5983	6004	6025	6045	6066	6087	6107	6128	6149	6169	6190
44	5682	5702	5723	5744	5764	5785	5805	5826	5847	5867	5888	5909	5929	5950	5971	5991	6012	6033	6053	6074	6095	6115	6136	6157	6177
45	5670	5690	5711	5732	5752	5773	5793	5814	5835	5855	5876	5896	5917	5938	5958	5979	5999	6020	6041	6061	6082	6102	6123	6144	6164
46	5657	5677	5698	5719	5739	5760	5780	5801	5821	5842	5862	5883	5904	5924	5945	5965	5986	6006	6027	6047	6068	6089	6109	6130	6150
47	5644	5664	5685	5706	5726	5747	5767	5788	5808	5829	5849	5870	5890	5911	5931	5952	5972	5993	6013	6034	6054	6075	6095	6116	6136
48	5631	5652	5672	5692	5713	5733	5754	5774	5795	5815	5836	5856	5877	5897	5918	5938	5959	5979	5999	6020	6040	6061	6081	6102	6122
49	5618	5639	5659	5679	5700	5720	5741	5761	5782	5802	5822	5843	5863	5884	5904	5924	5945	5965	5986	6006	6027	6047	6067	6088	6108
50	5605	5626	5646	5666	5687	5707	5728	5748	5768	5789	5809	5829	5850	5870	5891	5911	5931	5952	5972	5992	6013	6033	6054	6074	6094
51	5593	5613	5633	5653	5674	5694	5714	5735	5755	5775	5796	5816	5836	5857	5877	5897	5918	5938	5958	5979	5999	6019	6040	6060	6080
52	5580	5600	5620	5640	5661	5681	5701	5722	5742	5762	5782	5803	5823	5843	5864	5884	5904	5924	5945	5965	5985	6005	6026	6046	6066
53	5568	5588	5608	5628	5649	5669	5689	5709	5730	5750	5770	5790	5810	5831	5851	5871	5891	5912	5932	5952	5972	5993	6013	6033	6053
54	5555	5575	5595	5615	5636	5656	5676	5696	5716	5736	5757	5777	5797	5817	5837	5858	5878	5898	5918	5938	5959	5979	5999	6019	6039
55	5542	5562	5582	5602	5622	5643	5663	5683	5703	5723	5743	5763	5784	5804	5824	5844	5864	5884	5904	5925	5945	5965	5985	6005	6025

COMP. INLET TEMP. °F	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.7	30.8	30.9	31.0	31.1	31.2	31.3	31.4	31.5	MAXIMUM ALLOWABLE S.F.C. #/HR/#F	COMP. INLET TEMP. °F
18	6528	6549	6571	6593	6615	6636	6658	6680	6702	6723	6745	6767	6789	6810	6832	6854	1.062	18
19	6516	6537	6559	6581	6602	6624	6646	6668	6689	6711	6733	6754	6776	6798	6820	6841	1.061	19
20	6504	6525	6547	6569	6590	6612	6634	6655	6677	6699	6720	6742	6764	6785	6807	6829	1.061	20
21	6492	6513	6535	6557	6578	6600	6621	6643	6665	6686	6708	6730	6751	6773	6794	6816	1.060	21
22	6481	6502	6524	6545	6567	6589	6610	6632	6653	6675	6697	6718	6740	6761	6783	6804	1.060	22
23	6469	6490	6512	6533	6555	6576	6598	6619	6641	6662	6684	6706	6727	6749	6770	6792	1.060	23
24	6457	6478	6500	6521	6543	6564	6586	6607	6629	6650	6672	6693	6715	6736	6758	6779	1.059	24
25	6445	6466	6487	6509	6530	6552	6573	6595	6616	6638	6659	6681	6702	6724	6745	6767	1.059	25
26	6431	6453	6474	6496	6517	6539	6560	6581	6603	6624	6646	6667	6689	6710	6731	6753	1.058	26
27	6418	6440	6461	6483	6504	6525	6547	6568	6590	6611	6632	6654	6675	6696	6718	6739	1.058	27
28	6405	6427	6448	6469	6471	6512	6533	6555	6576	6597	6619	6640	6661	6683	6704	6725	1.058	28
29	6392	6414	6435	6456	6477	6499	6520	6541	6563	6584	6605	6627	6648	6669	6690	6712	1.058	29
30	6379	6401	6422	6443	6464	6486	6507	6528	6549	6571	6592	6613	6634	6656	6677	6698	1.058	30
31	6366	6387	6409	6430	6451	6472	6494	6515	6536	6557	6578	6600	6621	6642	6663	6684	1.058	31
32	6353	6374	6396	6417	6438	6459	6480	6501	6523	6544	6565	6586	6607	6628	6650	6671	1.057	32
33	6340	6361	6382	6404	6425	6446	6467	6488	6509	6530	6551	6573	6594	6615	6636	6657	1.057	33
34	6327	6348	6369	6390	6411	6433	6454	6475	6496	6517	6538	6559	6580	6601	6622	6643	1.057	34
35	6314	6335	6356	6377	6398	6419	6440	6461	6482	6503	6525	6546	6567	6588	6609	6630	1.057	35
36	6301	6322	6343	6364	6385	6406	6427	6448	6469	6490	6511	6532	6553	6574	6595	6616	1.057	36
37	6288	6309	6330	6351	6372	6393	6414	6435	6456	6477	6497	6518	6539	6560	6581	6602	1.057	37
38	6276	6297	6318	6339	6360	6381	6401	6422	6443	6464	6485	6506	6527	6548	6569	6590	1.057	38
39	6263	6384	6305	6326	6346	6367	6388	6409	6430	6451	6472	6492	6513	6534	6555	6576	1.057	39
40	6250	6271	6292	6312	6333	6354	6375	6396	6417	6437	6458	6479	6500	6521	6542	6562	1.057	40
41	6237	6258	6278	6299	6320	6341	6362	6382	6403	6424	6445	6465	6486	6507	6528	6549	1.057	41
42	6224	6245	6265	6286	6307	6328	6348	6369	6390	6411	6431	6452	6473	6494	6514	6535	1.057	42
43	6211	6232	6252	6273	6294	6314	6335	6356	6376	6397	6418	6438	6459	6480	6501	6521	1.057	43
44	6198	6218	6239	6260	6280	6301	6322	6342	6363	6384	6404	6425	6446	6466	6487	6508	1.057	44
45	6185	6205	6226	6247	6267	6288	6308	6329	6350	6370	6391	6411	6432	6453	6473	6494	1.057	45
46	6171	6191	6212	6232	6253	6274	6294	6315	6335	6356	6376	6397	6417	6438	6459	6479	1.057	46
47	6157	6177	6198	6218	6239	6259	6280	6300	6321	6341	6362	6382	6403	6423	6444	6464	1.057	47
48	6143	6163	6184	6204	6225	6245	6265	6286	6306	6327	6347	6368	6388	6409	6429	6450	1.058	48
49	6129	6149	6169	6190	6210	6231	6251	6272	6292	6312	6333	6353	6374	6394	6414	6435	1.058	49
50	6115	6135	6155	6176	6196	6217	6237	6257	6278	6298	6318	6339	6359	6379	6400	6420	1.058	50
51	6101	6121	6141	6162	6182	6202	6223	6243	6263	6284	6304	6324	6344	6365	6385	6405	1.058	51
52	6087	6107	6127	6147	6168	6188	6208	6228	6249	6269	6289	6310	6330	6350	6370	6391	1.058	52
53	6074	6094	6114	6134	6154	6175	6195	6215	6235	6256	6276	6296	6316	6337	6357	6377	1.058	53
54	6059	6080	6100	6120	6140	6160	6181	6201	6221	6241	6261	6282	6302	6322	6342	6362	1.058	54
55	6045	6066	6086	6106	6126	6146	6166	6186	6207	6227	6247	6267	6287	6307	6327	6348	1.059	55

J47-23585-1-FO

Figure 7–25. Performance Chart 25 and 27 7953

MODEL J47-GE-25 J47-GE-27

7953 RPM

CHART CALCULATED FOR RAM DIFFERENTIAL PRESSURE O INCH H_2O

MAXIMUM ALLOWABLE EXHAUST GAS TEMPERATURE 690°C (1275°F)

VAPOR PRESSURE CORRECTION CHART

VAPOR PRESS. ("HG)	1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	1.1	1.2
THRUST CORR. (SUBT)	2	4	6	8	10	12	14	16	18	20	22	24
SFC CORR. (ADD)	002	.003	.004	.006	.007	.009	.010	.012	.014	.015	.016	.018
EGT CORR. (SUBT)	1	1	1	2	2	3	3	4	4	5	5	6

MINIMUM ALLOWABLE THRUST - POUNDS
COMPRESSOR INLET PRESSURE - INCHES HG ABSOLUTE

COMP. INLET TEMP. °F	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	26.0	26.1	26.2	26.3	26.4	26.5	26.6	26.7
-20	5811	5835	5858	5881	5904	5927	5951	5974	5997	6020	6044	6067	6090	6113	6137	6160	6183	6206
-19	5802	5825	5848	5872	5895	5918	5941	5964	5988	6011	6034	6057	6080	6104	6127	6150	6173	6196
-18	5793	5816	5839	5862	5886	5909	5932	5955	5978	6001	6024	6048	6071	6094	6117	6140	6163	6187
-17	5785	5808	5831	5854	5877	5900	5923	5946	5970	5993	6016	6039	6062	6085	6108	6131	6155	6178
-16	5775	5798	5822	5845	5868	5891	5914	5937	5960	5983	6006	6029	6052	6076	6099	6122	6145	6168
-15	5766	5789	5812	5835	5858	5881	5904	5928	5951	5974	5997	6020	6043	6066	6089	6112	6135	6158
-14	5757	5780	5803	5826	5849	5872	5895	5918	5941	5964	5987	6010	6033	6056	6079	6102	6125	6148
-13	5748	5771	5794	5817	5840	5863	5886	5909	5932	5955	5978	6001	6024	6046	6069	6092	6115	6138
-12	5738	5761	5784	5807	5830	5852	5875	5898	5921	5944	5967	5990	6013	6036	6059	6082	6105	6128
-11	5729	5752	5775	5798	5821	5844	5867	5890	5913	5936	5958	5981	6004	6027	6050	6073	6096	6119
-10	5720	5743	5766	5789	5812	5835	5857	5880	5903	5926	5949	5972	5995	6017	6040	6063	6086	6109
-9	5710	5733	5756	5779	5802	5824	5847	5870	5893	5916	5938	5961	5984	6007	6030	6053	6075	6098
-8	5700	5723	5746	5769	5791	5814	5837	5860	5882	5905	5928	5951	5974	5996	6019	6042	6065	6088
-7	5690	5713	5736	5758	5781	5804	5827	5849	5872	5895	5918	5940	5963	5986	6009	6031	6054	6077
-6	5680	5703	5726	5748	5771	5794	5816	5839	5862	5884	5907	5930	5953	5975	5998	6021	6043	6066
-5	5670	5693	5715	5738	5761	5783	5806	5829	5851	5874	5897	5919	5942	5965	5987	6010	6033	6055
-4	5660	5683	5705	5728	5751	5773	5796	5818	5841	5864	5886	5909	5932	5954	5977	5999	6022	6045
-3	5650	5673	5695	5718	5740	5763	5786	5808	5831	5853	5876	5899	5921	5944	5966	5989	6011	6034
-2	5640	5663	5685	5708	5730	5753	5775	5798	5820	5843	5865	5888	5911	5933	5956	5978	6001	6023
-1	5630	5653	5675	5698	5720	5743	5765	5788	5810	5833	5855	5878	5900	5923	5945	5968	5990	6013
0	5620	5642	5665	5687	5710	5732	5755	5777	5800	5822	5845	5867	5890	5912	5935	5957	5979	6002
1	5610	5632	5655	5677	5700	5722	5744	5767	5789	5812	5834	5857	5879	5901	5924	5946	5969	5991
2	5600	5622	5645	5667	5689	5712	5734	5757	5779	5801	5824	5846	5869	5891	5913	5936	5958	5980
3	5590	5612	5635	5657	5679	5702	5724	5746	5769	5791	5813	5836	5858	5880	5903	5925	5947	5970
4	5580	5602	5625	5647	5669	5691	5714	5736	5758	5781	5803	5825	5848	5870	5892	5914	5937	5959
5	5571	5593	5615	5638	5660	5682	5704	5727	5749	5771	5793	5816	5838	5860	5882	5905	5927	5949
6	5560	5583	5605	5627	5650	5672	5694	5716	5738	5761	5783	5805	5827	5850	5872	5894	5916	5939
7	5551	5573	5595	5617	5939	5662	5684	5706	5728	5750	5773	5795	5817	5839	5861	5883	5906	5928
8	5541	5563	5585	5607	5629	5651	5673	5696	5718	5740	5762	5784	5806	5829	5851	5873	5895	5917
9	5531	5553	5575	5597	5619	5641	5663	5685	5707	5730	5752	5774	5796	5818	5840	5862	5884	5906
10	5521	5543	5565	5587	5609	5631	5653	5675	5697	5719	5741	5763	5785	5807	5829	5852	5874	5896
11	5511	5533	5555	5577	5599	5621	5643	5665	5687	5709	5731	5753	5775	5797	5819	5841	5863	5885
12	5500	5522	5544	5566	5588	5610	5632	5654	5676	5698	5720	5742	5764	5786	5808	5830	5852	5874
13	5490	5512	5534	5556	5578	5600	5622	5644	5666	5688	5710	5732	5754	5776	5798	5820	5842	5864
14	5480	5502	5524	5546	5568	5590	5612	5634	5656	5678	5700	5721	5743	5765	5787	5809	5831	5853
15	5470	5492	5514	5536	5558	5580	5602	5623	5645	5667	5689	5711	5733	5755	5777	5798	5820	5842
16	5460	5482	5504	5526	5548	5570	5591	5613	5635	5657	5679	5700	5722	5744	5766	5788	5810	5831
17	5450	5472	5494	5516	5538	5559	5581	5603	5625	5646	5668	5690	5712	5734	5755	5777	5799	5821

COMP. INLET TEMP. °F	26.8	26.9	27.0	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	28.0	28.1	28.2	28.3	28.4	28.5
-20	6229	6253	6276	6299	6322	6346	6369	6392	6415	6439	6462	6485	6508	6531	6555	6578	6601	6624
-19	6220	6243	6266	6289	6312	6336	6359	6382	6405	6428	6452	6475	6498	6521	6544	6567	6591	6614
-18	6210	6233	6256	6279	6302	6326	6349	6372	6395	6418	6441	6464	6488	6511	6534	6557	6580	6603
-17	6201	6224	6247	6270	6293	6316	6340	6363	6386	6409	6432	6455	6478	6501	6525	6548	6571	6594
-16	6191	6214	6237	6260	6283	6306	6329	6353	6376	6399	6422	6445	6468	6491	6514	6537	6560	6583
-15	6181	6204	6227	6250	6273	6296	6319	6342	6365	6389	6412	6435	6458	6481	6504	6527	6550	6573
-14	6171	6194	6217	6240	6263	6286	6309	6332	6355	6378	6401	6424	6447	6470	6493	6516	6539	6562
-13	6161	6184	6207	6230	6253	6276	6299	6322	6345	6368	6391	6414	6437	6460	6483	6506	6529	6552
-12	6151	6174	6197	6219	6242	6265	6288	6311	6334	6357	6380	6403	6426	6449	6472	6495	6518	6541
-11	6142	6165	6187	6210	6233	6256	6279	6302	6325	6348	6371	6394	6416	6439	6462	6485	6508	6531
-10	6132	6155	6178	6200	6223	6246	6269	6292	6315	6338	6360	6383	6406	6429	6452	6475	6498	6521
-9	6121	6144	6167	6190	6212	6235	6258	6281	6304	6327	6349	6372	6395	6418	6441	6463	6486	6509
-8	6110	6133	6156	6179	6201	6224	6247	6270	6293	6315	6338	6361	6384	6407	6429	6452	6475	6498
-7	6100	6122	6145	6168	6191	6213	6236	6259	6282	6304	6327	6350	6373	6395	6418	6441	6464	6486
-6	6089	6112	6134	6157	6180	6202	6225	6248	6270	6293	6316	6339	6361	6384	6407	6429	6452	6475
-5	6078	6101	6123	6146	6169	6191	6214	6237	6259	6282	6305	6327	6350	6373	6395	6418	6441	6463
-4	6067	6090	6113	6135	6158	6180	6203	6226	6248	6271	6294	6316	6339	6361	6384	6407	6429	6452
-3	6057	6079	6102	6124	6147	6170	6192	6215	6237	6260	6282	6305	6328	6350	6373	6395	6418	6441
-2	6046	6068	6091	6113	6136	6159	6181	6204	6226	6249	6271	6294	6316	6339	6361	6384	6407	6429
-1	6035	6058	6080	6103	6125	6148	6170	6193	6215	6238	6260	6283	6305	6328	6350	6373	6395	6418
0	6024	6047	6069	6092	6114	6137	6159	6182	6204	6227	6249	6271	6294	6316	6339	6361	6384	6406
1	6014	6036	6058	6081	6103	6126	6148	6171	6193	6215	6238	6260	6283	6305	6328	6350	6372	6395
2	6003	6025	6048	6070	6092	6115	6137	6160	6182	6204	6227	6249	6271	6294	6316	6339	6361	6383
3	5992	6014	6037	6059	6081	6104	6126	6149	6171	6193	6216	6238	6260	6283	6305	6327	6350	6372
4	5981	6004	6026	6048	6071	6093	6115	6138	6160	6182	6204	6227	6249	6271	6294	6316	6338	6361
5	5971	5994	6016	6038	6061	6083	6105	6127	6150	6172	6194	6216	6239	6261	6283	6306	6328	6350
6	5961	5983	6005	6027	6050	6072	6094	6116	6139	6161	6183	6205	6227	6250	6272	6294	6316	6339
7	5950	5972	5994	6017	6039	6061	6083	6105	6128	6150	6172	6194	6216	6238	6261	6283	6305	6327
8	5939	5961	5984	6006	6028	6050	6072	6094	6116	6139	6161	6183	6205	6227	6247	6271	6294	6316
9	5929	5951	5973	5995	6017	6039	6061	6083	6105	6127	6150	6172	6194	6216	6238	6260	6282	6304
10	5918	5940	5962	5984	6006	6028	6050	6072	6094	6116	6138	6160	6183	6205	6227	6249	6271	6293
11	5907	5929	5951	5973	5995	6017	6039	6061	6083	6105	6127	6149	6171	6193	6215	6237	6259	6281
12	5896	5918	5940	5962	5984	6006	6028	6050	6072	6094	6116	6138	6160	6182	6204	6226	6248	6270
13	5886	5907	5929	5951	5973	5995	6017	6039	6061	6083	6105	6127	6149	6171	6193	6215	6237	6259
14	5875	5897	5919	5940	5962	5984	6006	6028	6050	6072	6094	6116	6138	6160	6181	6203	6225	6247
15	5864	5886	5908	5930	5951	5973	5995	6017	6039	6061	6083	6105	6126	6148	6170	6192	6214	6236
16	5853	5875	5897	5919	5941	5962	5984	6006	6028	6050	6072	6093	6115	6137	6159	6181	6203	6224
17	5843	5864	5886	5908	5930	5952	5973	5995	6017	6039	6060	6082	6104	6126	6148	6169	6191	6213

COMP. INLET TEMP. °F	28.6	28.7	28.8	28.9	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.9	30.0	30.1	30.2	30.3
-20	6648	6671	6694	6717	6741	6764	6787	6810	6833	6857	6880	6903	6926	6950	6973	6996	7019	7042
-19	6637	6660	6683	6707	6730	6753	6776	6799	6823	6846	6869	6892	6915	6939	6962	6985	7008	7031
-18	6627	6650	6673	6696	6719	6742	6765	6789	6812	6835	6858	6881	6904	6928	6951	6974	6997	7020
-17	6617	6640	6663	6686	6710	6733	6756	6779	6802	6825	6848	6871	6895	6918	6941	6964	6987	7010
-16	6606	6630	6653	6676	6699	6722	6745	6768	6791	6814	6837	6860	6884	6907	6930	6953	6976	6999
-15	6596	6619	6642	6665	6688	6711	6734	6757	6780	6803	6826	6850	6873	6896	6919	6942	6965	6988
-14	6585	6608	6631	6655	6678	6701	6724	6747	6770	6793	6816	6839	6862	6885	6908	6931	6954	6977
-13	6575	6598	6621	6644	6667	6690	6713	6736	6759	6782	6805	6828	6851	6874	6897	6920	6943	6966
-12	6563	6586	6609	6632	6655	6678	6701	6724	6747	6770	6793	6816	6839	6862	6885	6908	6930	6953
-11	6554	6577	6600	6623	6646	6668	6691	6714	6737	6760	6783	6806	6829	6852	6875	6897	6920	6943
-10	6543	6566	6589	6612	6635	6658	6681	6703	6726	6749	6772	6795	6818	6841	6864	6886	6909	6932
-9	6532	6555	6578	6600	6623	6646	6669	6692	6715	6737	6760	6783	6806	6829	6852	6874	6897	6920
-8	6520	6543	6566	6589	6612	6634	6657	6680	6703	6726	6748	6771	6794	6817	6839	6862	6885	6908
-7	6509	6532	6555	6577	6600	6623	6645	6668	6691	6714	6736	6759	6782	6805	6827	6850	6873	6896
-6	6498	6520	6543	6566	6588	6611	6634	6656	6679	6702	6725	6747	6770	6793	6815	6838	6861	6884
-5	6486	6509	6531	6554	6577	6599	6622	6645	6667	6690	6713	6735	6758	6781	6803	6826	6849	6871
-4	6475	6497	6520	6542	6565	6588	6610	6633	6656	6678	6701	6723	6746	6769	6791	6814	6837	6859
-3	6463	6486	6508	6531	6554	6576	6599	6621	6644	6666	6689	6712	6734	6757	6779	6802	6825	6847
-2	6452	6474	6497	6519	6542	6564	6587	6609	6632	6655	6677	6700	6722	6745	6767	6790	6812	6835
-1	6440	6463	6485	6508	6530	6553	6575	6598	6620	6643	6665	6688	6710	6733	6755	6778	6800	6823
0	6429	6451	6474	6496	6519	6541	6564	6586	6608	6631	6653	6676	6698	6721	6743	6766	6788	6811
1	6417	6440	6462	6484	6507	6529	6552	6574	6597	6619	6641	6664	6686	6709	6731	6754	6776	6798
2	6406	6428	6451	6473	6495	6518	6540	6562	6585	6607	6630	6652	6674	6697	6719	6742	6764	6786
3	6394	6417	6439	6461	6484	6506	6528	6551	6573	6595	6618	6640	6662	6685	6707	6729	6752	6774
4	6383	6405	6427	6450	6472	6494	6517	6539	6561	6584	6606	6628	6651	6673	6695	6717	6740	6762
5	6372	6395	6417	6439	6461	6484	6506	6528	6550	6573	6595	6617	6640	6662	6684	6706	6729	6751
6	6361	6383	6405	6428	6450	6472	6494	6516	6539	6561	6583	6605	6628	6650	6672	6694	6716	6739
7	6349	6372	6394	6416	6438	6460	6483	6505	6527	6549	6571	6593	6616	6638	6660	6682	6704	6727
8	6338	6360	6382	6404	6427	6449	6471	6493	6515	6537	6559	6582	6604	6626	6648	6670	6692	6714
9	6326	6349	6371	6393	6415	6437	6459	6481	6503	6525	6548	6570	6592	6614	6636	6658	6680	6702
10	6315	6337	6359	6381	6403	6425	6447	6469	6491	6514	6536	6558	6580	6602	6624	6646	6668	6690
11	6303	6325	6348	6370	6392	6414	6436	6458	6480	6502	6524	6546	6568	6590	6612	6634	6656	6678
12	6292	6314	6336	6358	6380	6402	6424	6446	6468	6490	6512	6534	6556	6578	6600	6622	6644	6666
13	6281	6302	6324	6346	6368	6390	6412	6434	6456	6478	6500	6522	6544	6566	6588	6610	6632	6654
14	6269	6291	6313	6335	6357	6379	6400	6422	6444	6466	6488	6510	6532	6554	6576	6598	6620	6641
15	6258	6279	6301	6323	6345	6367	6389	6411	6433	6454	6476	6498	6520	6542	6564	6586	6607	6639
16	6246	6268	6290	6312	6333	6355	6377	6399	6421	6443	6464	6486	6508	6530	6552	6574	6595	6617
17	6235	6257	6278	6300	6322	6344	6365	6387	6409	6431	6453	6474	6496	6518	6540	6562	6583	6605

COMP. INLET TEMP. °F	30.4	30.5	30.6	30.7	30.8	30.9	31.0	31.1	31.2	31.3	31.4	31.5	MAXIMUM ALLOWABLE S.F.C. #/HR/#F	COMP. INLET TEMP. °F
-20	7066	7089	7112	7135	7159	7182	7205	7228	7252	7275	7298	7321	1.100	-20
-19	7055	7078	7101	7124	7147	7170	7194	7217	7240	7263	7286	7310	1.098	-19
-18	7043	7067	7090	7113	7136	7159	7182	7205	7229	7252	7275	7298	1.097	-18
-17	7033	7056	7079	7103	7126	7149	7172	7195	7218	7241	7264	7288	1.096	-17
-16	7022	7045	7068	7091	7114	7137	7161	7184	7207	7230	7253	7276	1.094	-16
-15	7011	7034	7057	7080	7103	7126	7149	7172	7195	7218	7241	7264	1.093	-15
-14	7000	7023	7046	7069	7092	7115	7138	7161	7184	7207	7230	7253	1.092	-14
-13	6989	7011	7034	7057	7080	7103	7126	7149	7172	7195	7218	7241	1.091	-13
-12	6976	6999	7022	7045	7068	7091	7114	7137	7160	7183	7206	7229	1.089	-12
-11	6966	6989	7012	7035	7058	7081	7104	7126	7149	7172	7195	7218	1.088	-11
-10	6955	6978	7001	7024	7046	7069	7092	7115	7138	7161	7184	7206	1.087	-10
-9	6943	6966	6988	7011	7034	7057	7080	7103	7125	7148	7171	7194	1.086	-9
-8	6931	6953	6976	6999	7022	7045	7067	7090	7113	7136	7158	7181	1.084	-8
-7	6918	6941	6964	6987	7009	7032	7055	7078	7100	7123	7146	7169	1.083	-7
-6	6906	6929	6952	6974	6997	7020	7042	7065	7088	7111	7133	7156	1.082	-6
-5	6894	6917	6939	6962	6985	7007	7030	7053	7075	7098	7121	7143	1.081	-5
-4	6882	6904	6927	6950	6972	6995	7018	7040	7063	7085	7108	7131	1.080	-4
-3	6870	6892	6915	6937	6960	6983	7005	7028	7050	7073	7096	7118	1.079	-3
-2	6857	6880	6903	6925	6948	6970	6993	7015	7038	7060	7083	7105	1.078	-2
-1	6845	6868	6890	6913	6935	6958	6980	7003	7025	7048	7070	7093	1.077	-1
0	6833	6856	6878	6901	6923	6945	6968	6990	7013	7035	7058	7080	1.076	0
1	6821	6843	6866	6888	6911	6933	6955	6978	7000	7023	7045	7068	1.075	1
2	6809	6831	6853	6876	6898	6921	6943	6965	6988	7010	7033	7055	1.074	2
3	6797	6819	6841	6864	6886	6908	6931	6953	6975	6998	7020	7042	1.073	3
4	6784	6807	6829	6851	6874	6896	6918	6941	6963	6985	7007	7030	1.072	4
5	6773	6795	6818	6840	6862	6885	6907	6929	6951	6974	6996	7018	1.071	5
6	6761	6783	6805	6828	6850	6872	6894	6917	6939	6961	6983	7005	1.070	6
7	6749	6771	6793	6815	6838	6860	6882	6904	6926	6948	6971	6993	1.069	7
8	6737	6759	6781	6803	6825	6847	6869	6892	6914	6936	6958	6980	1.069	8
9	6724	6746	6769	6791	6813	6835	6857	6879	6901	6923	6945	6968	1.068	9
10	6712	6734	6756	6778	6800	6822	6845	6867	6889	6911	6933	6955	1.067	10
11	6700	6722	6744	6766	6788	6810	6832	6854	6876	6898	6920	6942	1.066	11
12	6688	6710	6732	6754	6776	6798	6820	6842	6864	6886	6908	6930	1.066	12
13	6676	6698	6719	6741	6763	6785	6807	6829	6851	6873	6895	6917	1.065	13
14	6663	6685	6707	6729	6751	6773	6795	6817	6839	6861	6882	6904	1.064	14
15	6651	6673	6695	6717	6739	6761	6782	6804	6826	6848	6870	6892	1.064	15
16	6639	6661	6683	6705	6726	6748	6770	6792	6814	6836	6857	6879	1.063	16
17	6627	6649	6670	6692	6714	6736	6758	6779	6801	6823	6845	6867	1.062	17

J47-23587-1-FO

Figure 7–24. Performance Chart 25 and 27 7953

quick disconnect hoses for the required test cell instrumentation sensing, service connections and drain lines.

Note

Cover all engine openings, such as vents, oil in and out, compressor intake, turbine exhaust outlet, etc., while engine is awaiting test.

7–71. INSTALLATION PROCEDURE.

7–72. GENERAL. Due to variation in construction of the different type test stands and thrust beds, precise installation instructions cannot be included in this technical order. In general, the following listed procedure is common to all facilities and will be accomplished insofar as they may be applied to the type equipment being used.

a. Transport engine to test site, (See Para. 7–21) position in the thrust frame and secure. See Figure 7–8.

b. Open all vents and drain lines.

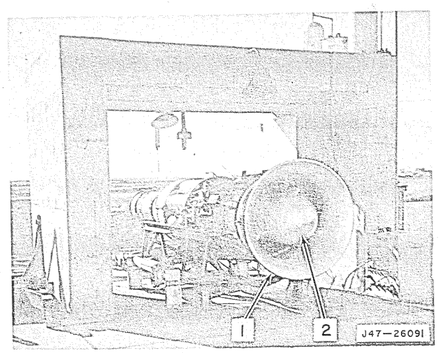
c. Install the throttle receiver and bracket (figure 7–9). Connect Nr 4 island throttle linkage, ascertain that the control throttle has spring-back in both the open and closed position and that the linkage has full travel from cut-off to full throttle stop.

d. Install vibration pickups as follows:

(1) Mount compressor vibration pickup on one of the forward frame mounting pads (3, 9, or 12 o'clock position).

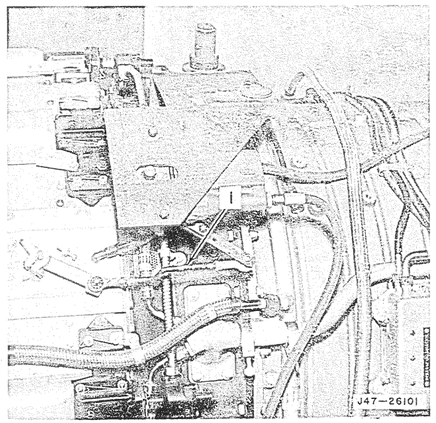
(2) If compressor pickup is mounted at 12 o'clock position, mount turbine pickup at 3 or 9 o'clock on the aft flange of the turbine casing. If the compressor pickup is mounted at 3 or 9 o'clock position, mount turbine pickup at 12 o'clock position on the aft flange of the turbine casing.

e. Connect the following electrical connections:



1. Bellmouth
2. Bulletnose

Figure 7–8. Engine Installed in Test Stand



1. Throttle Control

Figure 7–9. Throttle Control Rod

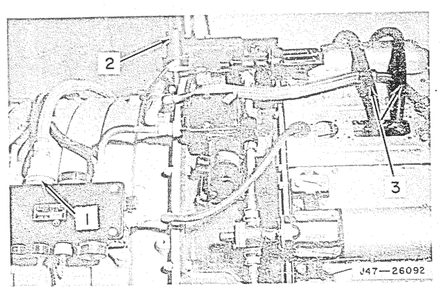
Note

Refer to the applicable electrical wiring schematic, Figure 7–6 or 7–7.

(1) Tachometer generator connector (AN 3106-32-68, Engine "J" box, -23 and -25 model, or AN 3106-28-11S, Engine "J" box, -27 model).

(2) Main electrical connector (figure 7–10), AN 3106-28-11S, engine "J" box, -23, -25 and -27 models.

(3) Starter-generator leads: A, C, and E.



1. Main Electrical Connection
2. Vibration Pickup
3. Starter Leads

Figure 7–10. Main Electrical Connection

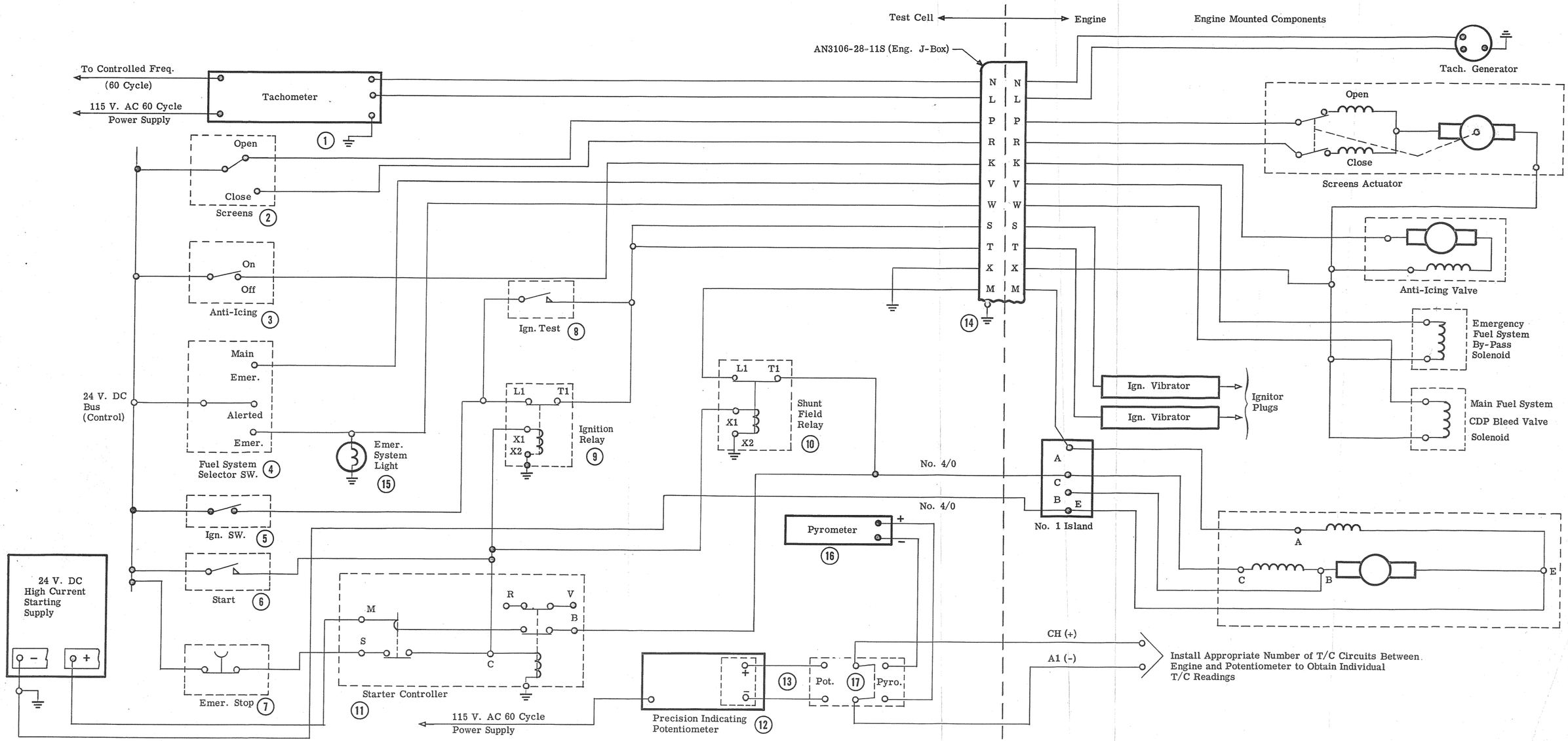


Figure 7-7. Wiring Schematic (-27)

MODEL J47-GE-23

7953 RPM

CHART CALCULATED FOR RAM DIFFERENTIAL PRESSURE O INCH H_2O

MAXIMUM ALLOWABLE EXHAUST GAS TEMPERATURE 690°C (1275°F)

VAPOR PRESSURE CORRECTION CHART

VAPOR PRESSURE ("HG)	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85	.90	.95	1.00	1.05	1.10	1.15	1.20
THRUST CORR. (SUBT)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
SFC CORR. (ADD.)	.001	.002	.002	.003	.004	.005	.005	.006	.007	.008	.008	.009	.010	.011	.011	.012	.013	.014	.014	.015	.016	.017	.017	.018
T.P.T. CORR. (SUBT.)	1	1	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	4	5	5	5	5	6

MINIMUM ALLOWABLE THRUST - POUNDS
COMPRESSOR INLET PRESSURE - INCHES HG ABSOLUTE

COMP. INLET TEMP. °F	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	26.0	26.1	26.2	26.3	26.4	26.5	26.6	26.7	26.8
18	5358	5379	5400	5422	5443	5465	5486	5508	5529	5550	5572	5593	5615	5636	5657	5679	5700	5722	5743
19	5348	5369	5390	5412	5433	5454	5476	5497	5519	5540	5561	5583	5604	5625	5647	5668	5690	5711	5732
20	5337	5358	5379	5401	5422	5443	5465	5486	5507	5529	5550	5571	5593	5614	5635	5657	5678	5699	5721
21	5326	5347	5368	5390	5411	5432	5454	5475	5496	5518	5539	5560	5581	5603	5624	5645	5667	5688	5709
22	5315	5336	5357	5379	5400	5421	5442	5464	5485	5506	5527	5549	5570	5591	5612	5634	5655	5676	5697
23	5305	5326	5347	5369	5390	5411	5432	5453	5475	5496	5517	5538	5559	5581	5602	5623	5644	5665	5687
24	5294	5315	5336	5358	5379	5400	5421	5442	5463	5485	5506	5527	5548	5569	5590	5612	5633	5654	5675
25	5284	5305	5326	5347	5369	5390	5411	5432	5453	5474	5495	5516	5538	5559	5580	5601	5622	5643	5664
26	5273	5294	5315	5336	5358	5379	5400	5421	5442	5463	5484	5505	5526	5547	5568	5589	5610	5632	5653
27	5262	5283	5304	5326	5347	5368	5389	5410	5431	5452	5473	5494	5515	5536	5557	5578	5599	5620	5641
28	5251	5272	5293	5314	5335	5356	5377	5398	5419	5440	5461	5482	5503	5524	5545	5566	5587	5608	5629
29	5241	5263	5283	5304	5325	5346	5367	5388	5409	5430	5451	5472	5493	5514	5535	5556	5577	5598	5619
30	5231	5252	5274	5293	5314	5335	5356	5377	5398	5419	5440	5461	5481	5502	5523	5544	5565	5586	5607
31	5220	5241	5261	5282	5303	5324	5345	5366	5387	5407	5428	5449	5470	5491	5512	5533	5554	5574	5595
32	5209	5230	5250	5271	5292	5313	5334	5355	5375	5396	5417	5438	5459	5479	5500	5521	5542	5563	5584
33	5198	5219	5240	5260	5281	5302	5323	5343	5364	5385	5406	5427	5447	5468	5489	5510	5530	5551	5572
34	5188	5209	5229	5250	5271	5292	5312	5333	5354	5375	5395	5416	5437	5457	5478	5499	5520	5540	5561
35	5178	5199	5219	5240	5261	5281	5302	5323	5343	5364	5385	5406	5426	5447	5468	5488	5509	5530	5550
36	5167	5188	5208	5229	5250	5270	5291	5312	5332	5353	5374	5394	5415	5436	5456	5477	5498	5518	5539
37	5157	5177	5198	5219	5240	5260	5281	5301	5322	5343	5363	5384	5404	5425	5446	5466	5487	5508	5528
38	5146	5167	5187	5208	5228	5249	5270	5290	5311	5331	5352	5372	5393	5414	5434	5455	5475	5496	5516
39	5135	5156	5176	5197	5218	5238	5259	5279	5300	5320	5341	5361	5382	5402	5423	5443	5464	5484	5505
40	5124	5145	5165	5186	5206	5227	5247	5268	5288	5309	5329	5350	5370	5391	5411	5432	5452	5473	5493
41	5114	5134	5154	5175	5195	5216	5236	5257	5277	5298	5318	5338	5359	5379	5400	5420	5441	5461	5482
42	5103	5123	5144	5164	5184	5205	5225	5246	5266	5286	5307	5327	5348	5368	5388	5409	5429	5450	5470
43	5092	5112	5133	5153	5173	5194	5214	5234	5255	5275	5295	5316	5336	5357	5377	5397	5418	5438	5458
44	5081	5101	5122	5142	5162	5183	5203	5223	5243	5264	5284	5304	5325	5345	5365	5386	5406	5426	5447
45	5070	5090	5111	5131	5151	5172	5192	5212	5232	5253	5273	5293	5313	5334	5354	5374	5394	5415	5435
46	5059	5080	5100	5120	5140	5160	5181	5201	5221	5241	5262	5282	5302	5322	5342	5363	5383	5403	5423
47	5048	5069	5089	5109	5129	5149	5169	5190	5210	5230	5250	5270	5291	5311	5331	5351	5371	5391	5412
48	5038	5058	5078	5098	5118	5138	5158	5179	5199	5219	5239	5259	5279	5299	5320	5340	5360	5380	5400
49	5027	5047	5067	5089	5107	5127	5147	5167	5187	5208	5228	5248	5268	5288	5308	5328	5348	5368	5388
50	5016	5036	5056	5076	5096	5116	5136	5156	5176	5196	5216	5236	5257	5277	5297	5317	5337	5357	5377
51	5005	5025	5045	5065	5085	5105	5125	5145	5165	5185	5205	5225	5245	5265	5285	5305	5325	5345	5365
52	4994	5014	5034	5054	5074	5094	5114	5134	5154	5174	5194	5214	5234	5254	5274	5294	5314	5333	5353
53	4983	5003	5023	5043	5063	5083	5103	5123	5143	5163	5183	5202	5222	5242	5262	5282	5302	5322	5342
54	4972	4992	5012	5032	5052	5072	5092	5112	5131	5151	5171	5191	5211	5231	5251	5271	5290	5310	5330
55	4962	4982	5002	5022	5042	5062	5081	5101	5121	5141	5161	5181	5200	5220	5240	5260	5280	5300	5319

COMP. INLET TEMP. °F	26.9	27.0	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	28.0	28.1	28.2	28.3	28.4	28.5	28.6
18	5765	5786	5807	5829	5850	5872	5893	5914	5936	5957	5979	6000	6021	6043	6064	6086	6107	6129
19	5754	5775	5796	5818	5839	5861	5882	5903	5925	5946	5968	5989	6010	6032	6053	6074	6096	6117
20	5742	5763	5785	5806	5827	5849	5870	5891	5913	5934	5955	5977	5998	6019	6041	6062	6083	6105
21	5730	5752	5773	5794	5816	5837	5858	5879	5901	5922	5943	5965	5986	6007	6028	6050	6071	6092
22	5719	5740	5761	5782	5804	5825	5846	5867	5889	5910	5931	5952	5974	5995	6016	6037	6059	6080
23	5708	5729	5750	5771	5793	5814	5835	5856	5877	5899	5920	5941	5962	5983	6005	6026	6047	6068
24	5696	5717	5739	5760	5781	5802	5823	5844	5865	5887	5908	5929	5950	5971	5992	6014	6035	6056
25	5685	5707	5728	5749	5770	5791	5812	5833	5854	5876	5897	5919	5939	5960	5981	6002	6023	6044
26	5674	5695	5716	5737	5758	5779	5800	5821	5842	5863	5884	5906	5927	5948	5969	5990	6011	6032
27	5662	5683	5704	5725	5746	5767	5788	5809	5830	5851	5872	5893	5914	5936	5957	5978	5999	6020
28	5650	5671	5692	5713	5734	5755	5776	5797	5818	5839	5860	5881	5902	5923	5944	5965	5986	6007
29	5639	5660	5681	5702	5723	5744	5765	5786	5807	5828	5849	5870	5891	5912	5933	5954	5975	5996
30	5628	5649	5670	5691	5711	5732	5753	5774	5795	5816	5837	5858	5879	5900	5921	5941	5962	5983
31	5616	5637	5658	5679	5700	5720	5741	5762	5783	5804	5825	5846	5867	5887	5908	5929	5950	5971
32	5604	5625	5646	5667	5688	5709	5729	5750	5771	5792	5813	5833	5854	5875	5896	5917	5938	5958
33	5593	5614	5634	5655	5676	5697	5717	5738	5759	5780	5801	5821	5842	5863	5884	5904	5925	5946
34	5582	5603	5623	5644	5665	5686	5706	5727	5748	5769	5789	5810	5831	5852	5872	5893	5914	5934
35	5571	5592	5613	5633	5654	5675	5695	5716	5737	5757	5778	5799	5820	5840	5861	5882	5902	5923
36	5560	5580	5601	5622	5642	5663	5683	5704	5725	5745	5766	5787	5807	5828	5849	5869	5890	5911
37	5549	5569	5590	5611	5631	5652	5672	5693	5714	5734	5755	5776	5796	5817	5837	5858	5879	5899
38	5537	5558	5578	5599	5619	5640	5660	5681	5702	5722	5743	5763	5784	5804	5825	5846	5866	5887
39	5525	5546	5566	5587	5608	5628	5649	5669	5690	5710	5731	5751	5772	5792	5813	5833	5854	5874
40	5514	5534	5555	5575	5596	5616	5637	5657	5677	5698	5718	5739	5759	5780	5800	5821	5841	5862
41	5502	5522	5543	5563	5584	5604	5625	5645	5666	5686	5706	5727	5747	5768	5788	5809	5829	5849
42	5490	5511	5531	5552	5572	5592	5613	5633	5654	5674	5694	5715	5735	5756	5776	5796	5817	5837
43	5479	5499	5519	5540	5560	5580	5601	5621	5641	5662	5682	5703	5723	5743	5764	5784	5804	5825
44	5467	5487	5508	5528	5548	5568	5589	5609	5629	5650	5670	5690	5711	5731	5751	5772	5792	5812
45	5455	5476	5496	5516	5536	5557	5577	5597	5617	5638	5658	5678	5698	5719	5739	5759	5780	5800
46	5444	5464	5484	5504	5524	5545	5565	5585	5605	5626	5646	5666	5686	5706	5727	5747	5767	5787
47	5432	5452	5472	5492	5513	5533	5553	5573	5593	5613	5634	5654	5674	5694	5714	5735	5755	5775
48	5420	5440	5460	5481	5501	5521	5541	5561	5581	5601	5622	5642	5662	5682	5702	5722	5742	5763
49	5408	5429	5449	5469	5489	5509	5529	5549	5569	5589	5609	5629	5650	5670	5690	5710	5730	5750
50	5397	5417	5437	5457	5477	5497	5517	5537	5557	5577	5597	5617	5637	5658	5678	5698	5718	5738
51	5385	5405	5425	5445	5465	5485	5505	5525	5545	5565	5585	5605	5625	5645	5665	5685	5705	5725
52	5373	5393	5413	5433	5453	5473	5493	5513	5533	5553	5573	5593	5613	5633	5653	5673	5693	5713
53	5362	5382	5402	5422	5441	5461	5481	5501	5521	5541	5561	5581	5601	5621	5641	5661	5681	5700
54	5350	5370	5390	5410	5430	5449	5469	5489	5509	5529	5549	5569	5589	5608	5628	5648	5668	5688
55	5339	5359	5379	5399	5419	5438	5458	5478	5498	5518	5538	5557	5577	5597	5617	5637	5657	5676

COMP. INLET TEMP. °F	28.7	28.8	28.9	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.9	30.0	30.1	30.2	30.3	30.4	30.5
18	6150	6171	6193	6214	6236	6257	6278	6300	6321	6343	6364	6386	6407	6428	6450	6471	6493	6514	6535
19	6139	6160	6181	6203	6224	6245	6267	6288	6310	6331	6352	6374	6395	6416	6438	6459	6481	6502	6523
20	6126	6147	6169	6190	6211	6233	6254	6275	6297	6318	6339	6361	6382	6403	6425	6446	6467	6489	6510
21	6114	6135	6156	6177	6199	6220	6241	6263	6284	6305	6326	6348	6369	6390	6412	6433	6454	6476	6497
22	6101	6122	6143	6165	6186	6207	6228	6250	6271	6292	6313	6335	6356	6377	6398	6420	6441	6462	6483
23	6090	6111	6132	6153	6174	6196	6217	6238	6259	6280	6302	6323	6344	6365	6386	6408	6429	6450	6471
24	6077	6098	6119	6141	6162	6183	6204	6225	6246	6268	6289	6310	6331	6352	6373	6395	6416	6437	6458
25	6066	6087	6108	6129	6150	6171	6192	6213	6235	6256	6277	6298	6319	6340	6361	6382	6404	6425	6446
26	6053	6074	6095	6116	6137	6159	6180	6201	6222	6243	6264	6285	6306	6327	6348	6369	6390	6411	6433
27	6041	6062	6083	6104	6125	6146	6167	6188	6209	6230	6251	6272	6293	6314	6335	6356	6377	6398	6419
28	6028	6049	6070	6091	6112	6133	6154	6175	6196	6217	6238	6259	6280	6301	6322	6343	6364	6385	6406
29	6017	6038	6059	6079	6100	6121	6142	6163	6184	6205	6226	6247	6268	6289	6310	6331	6352	6373	6394
30	6004	6025	6046	6067	6088	6109	6130	6151	6171	6192	6213	6234	6255	6276	6297	6318	6339	6360	6381
31	5992	6013	6033	6054	6075	6096	6117	6138	6159	6179	6200	6221	6242	6263	6284	6305	6326	6346	6367
32	5979	6000	6021	6042	6063	6083	6104	6125	6146	6167	6187	6208	6229	6250	6271	6292	6312	6333	6354
33	5967	5988	6008	6029	6050	6071	6091	6112	6133	6154	6175	6195	6216	6237	6258	6278	6299	6320	6341
34	5955	5976	5997	6017	6038	6059	6080	6100	6121	6142	6163	6183	6204	6225	6246	6266	6287	6308	6328
35	5944	5964	5985	6006	6027	6047	6068	6089	6109	6130	6151	6171	6192	6213	6233	6254	6275	6296	6316
36	5931	5952	5973	5993	6014	6035	6055	6076	6097	6117	6138	6159	6179	6200	6221	6241	6262	6282	6303
37	5920	5940	5961	5982	6002	6023	6044	6064	6085	6105	6126	6147	6167	6188	6208	6229	6250	6270	6291
38	5907	5928	5948	5969	5990	6010	6031	6051	6072	6092	6113	6134	6154	6175	6195	6216	6236	6257	6278
39	5895	5915	5936	5957	5977	5998	6018	6039	6059	6080	6100	6121	6141	6162	6182	6203	6223	6244	6264
40	5882	5903	5923	5944	5964	5985	6005	6026	6046	6067	6087	6108	6128	6149	6169	6190	6210	6231	6251
41	5870	5890	5911	5931	5952	5972	5993	6013	6033	6054	6074	6095	6115	6136	6156	6177	6197	6217	6238
42	5857	5878	5898	5919	5939	5959	5980	6000	6021	6041	6061	6082	6102	6123	6143	6163	6184	6204	6225
43	5845	5865	5886	5906	5926	5947	5967	5987	6008	6028	6049	6069	6089	6110	6130	6150	6171	6191	6211
44	5833	5853	5873	5893	5914	5934	5954	5975	5995	6015	6036	6056	6076	6097	6117	6137	6157	6178	6198
45	5820	5840	5861	5881	5901	5921	5942	5962	5982	6002	6023	6043	6063	6084	6104	6124	6144	6165	6185
46	5808	5828	5848	5868	5888	5909	5929	5949	5969	5990	6010	6030	6050	6071	6091	6111	6131	6151	6172
47	5795	5815	5835	5856	5876	5896	5916	5936	5957	5977	5997	6017	6037	6057	6078	6098	6118	6138	6158
48	5783	5803	5823	5843	5863	5883	5903	5924	5944	5964	5984	6004	6024	6044	6065	6085	6105	6124	6145
49	5770	5790	5810	5830	5851	5871	5891	5911	5931	5951	5971	5991	6011	6031	6051	6072	6092	6112	6132
50	5758	5778	5798	5818	5838	5858	5878	5898	5918	5938	5958	5978	5998	6018	6038	6059	6079	6099	6119
51	5745	5765	5785	5805	5825	5845	5865	5885	5905	5925	5945	5965	5985	6005	6025	6045	6065	6085	6105
52	5733	5753	5773	5793	5813	5833	5853	5872	5892	5912	5932	5952	5972	5992	6012	6032	6052	6072	6092
53	5720	5740	5760	5780	5800	5820	5840	5860	5880	5900	5920	5939	5959	5979	5999	6019	6039	6059	6079
54	5708	5728	5748	5767	5787	5807	5827	5847	5867	5887	5907	5926	5946	5966	5986	6006	6026	6046	6066
55	5696	5716	5736	5756	5776	5796	5815	5835	5855	5875	5895	5915	5934	5954	5974	5994	6014	6034	6053

COMP. INLET TEMP. °F	30.6	30.7	30.8	30.9	31.0	31.1	31.2	31.3	31.4	31.5	MAXIMUM ALLOWABLE S.F.C. #/HR/#F	COMP. INLET TEMP. °F
18	6557	6578	6600	6621	6643	6664	6685	6707	6728	6750	1.092	18
19	6545	6566	6587	6609	6630	6652	6673	6694	6716	6737	1.092	19
20	6531	6553	6574	6595	6617	6638	6659	6681	6702	6723	1.092	20
21	6518	6539	6561	6582	6603	6625	6646	6667	6688	6710	1.092	21
22	6505	6526	6547	6568	6590	6611	6632	6653	6675	6696	1.092	22
23	6492	6514	6535	6556	6577	6598	6620	6641	6662	6683	1.092	23
24	6479	6500	6521	6543	6564	6585	6606	6627	6648	6670	1.092	24
25	6467	6488	6509	6530	6551	6573	6594	6615	6636	6657	1.092	25
26	6454	6475	6496	6517	6538	6559	6580	6601	6622	6643	1.092	26
27	6440	6461	6482	6503	6525	6546	6567	6588	6609	6630	1.092	27
28	6427	6448	6469	6490	6511	6532	6553	6574	6595	6616	1.091	28
29	6415	6436	6457	6478	6499	6519	6540	6561	6582	6603	1.091	29
30	6401	6422	6443	6464	6485	6506	6527	6548	6569	6590	1.091	30
31	6388	6409	6430	6451	6472	6492	6513	6534	6555	6576	1.091	31
32	6375	6396	6416	6437	6458	6479	6500	6521	6541	6562	1.091	32
33	6362	6382	6403	6424	6445	6465	6486	6507	6528	6549	1.090	33
34	6349	6370	6391	6411	6432	6453	6474	6494	6515	6536	1.090	34
35	6337	6358	6378	6399	6420	6440	6461	6482	6503	6523	1.090	35
36	6324	6344	6365	6386	6406	6427	6448	6468	6489	6510	1.090	36
37	6311	6332	6353	6373	6394	6415	6435	6456	6476	6497	1.090	37
38	6298	6319	6339	6360	6380	6401	6422	6442	6463	6483	1.090	38
39	6285	6305	6326	6347	6367	6388	6408	6429	6449	6470	1.090	39
40	6272	6292	6312	6333	6353	6374	6394	6415	6435	6456	1.090	40
41	6258	6279	6299	6320	6340	6361	6381	6401	6422	6442	1.090	41
42	6245	6265	6286	6306	6327	6347	6367	6388	6408	6429	1.090	42
43	6232	6252	6272	6293	6313	6333	6354	6374	6395	6415	1.090	43
44	6218	6239	6259	6279	6300	6320	6340	6361	6381	6401	1.089	44
45	6205	6225	6246	6266	6286	6306	6327	6347	6367	6388	1.089	45
46	6192	6212	6232	6253	6273	6293	6313	6333	6354	6374	1.089	46
47	6178	6199	6219	6239	6259	6279	6300	6320	6340	6360	1.089	47
48	6165	6185	6206	6226	6246	6266	6286	6306	6326	6347	1.089	48
49	6152	6172	6192	6212	6232	6252	6272	6293	6313	6333	1.089	49
50	6139	6159	6179	6199	6219	6239	6259	6279	6299	6319	1.089	50
51	6125	6145	6165	6185	6205	6225	6245	6265	6285	6305	1.089	51
52	6112	6132	6152	6172	6192	6212	6232	6252	6272	6292	1.089	52
53	6099	6119	6139	6159	6179	6198	6218	6238	6258	6278	1.090	53
54	6085	6105	6125	6145	6165	6185	6205	6225	6244	6264	1.090	54
55	6073	6093	6113	6133	6153	6172	6192	6212	6232	6252	1.090	55

J47-23574

Figure 7-21. Performance Chart -23 7953

MODEL J47-GE-23

7953 RPM

CHART CALCULATED FOR RAM DIFFERENTIAL PRESSURE O INCH H_2O

MAXIMUM ALLOWABLE EXHAUST GAS TEMPERATURE 690°C (1275°F)

VAPOR PRESSURE CORRECTION CHART

VAPOR PRESSURE ("HG)	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85	.90	.95	1.00	1.05	1.10	1.15	1.20
THRUST CORR. (SUBT)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
SFC CORR. (ADD.)	.001	.002	.002	.003	.004	.005	.005	.006	.007	.008	.008	.009	.010	.011	.011	.012	.013	.014	.014	.015	.016	.017	.017	.018
T.P.T. CORR. (SUBT.)	1	1	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	4	5	5	5	5	6

MINIMUM ALLOWABLE THRUST - POUNDS
COMPRESSOR INLET PRESSURE - INCHES HG ABSOLUTE

COMP. INLET TEMP. °F	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	26.0	26.1	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9	27.0	27.1	27.2	27.3
-20	5724	5746	5769	5792	5815	5838	5861	5884	5907	5930	5952	5975	5998	6021	6044	6067	6090	6113	6135	6158	6181	6204	6227	6250
-19	5715	5738	5761	5784	5807	5829	5852	5875	5898	5921	5944	5967	5989	6012	6035	6058	6081	6104	6126	6149	6172	6195	6218	6241
-18	5707	5730	5752	5775	5798	5821	5844	5866	5889	5912	5935	5958	5981	6003	6026	6049	6072	6095	6117	6140	6163	6186	6209	6231
-17	5698	5721	5744	5766	5789	5812	5835	5857	5880	5903	5926	5949	5971	5994	6017	6040	6062	6085	6108	6131	6154	6176	6199	6222
-16	5690	5713	5735	5758	5781	5804	5826	5849	5872	5895	5917	5940	5963	5986	6008	6031	6054	6077	6099	6122	6145	6168	6190	6213
-15	5682	5705	5727	5750	5773	5795	5818	5841	5863	5886	5909	5932	5954	5977	6000	6022	6045	6068	6091	6113	6136	6159	6181	6204
-14	5673	5695	5718	5741	5763	5786	5809	5831	5854	5877	5899	5922	5945	5967	5990	6013	6035	6058	6081	6103	6126	6149	6171	6194
-13	5663	5686	5709	5731	5754	5777	5799	5822	5845	5867	5890	5912	5935	5958	5980	6003	6026	6048	6071	6094	6116	6139	6161	6184
-12	5654	5677	5699	5722	5745	5767	5790	5812	5835	5858	5880	5903	5925	5948	5971	5993	6016	6038	6061	6084	6106	6129	6151	6174
-11	5645	5668	5690	5713	5735	5758	5780	5803	5826	5848	5871	5893	5916	5938	5961	5983	6006	6029	6051	6074	6096	6119	6141	6164
-10	5636	5658	5681	5703	5726	5748	5771	5793	5816	5839	5861	5884	5906	5929	5951	5974	5996	6019	6041	6064	6086	6109	6131	6154
-9	5627	5649	5672	5694	5717	5739	5762	5784	5807	5829	5852	5874	5896	5919	5941	5964	5986	6009	6031	6054	6076	6099	6121	6144
-8	5617	5640	5662	5685	5707	5730	5752	5775	5797	5819	5842	5864	5887	5909	5932	5954	5977	5999	6022	6044	6067	6089	6111	6134
-7	5608	5631	5653	5676	5698	5720	5743	5765	5788	5810	5832	5855	5877	5900	5922	5945	5967	5989	6012	6034	6057	6079	6101	6124
-6	5599	5621	5644	5666	5689	5711	5733	5756	5778	5801	5823	5845	5868	5890	5912	5935	5957	5980	6002	6024	6047	6069	6091	6114
-5	5590	5612	5635	5657	5679	5702	5724	5746	5769	5791	5813	5836	5858	5880	5903	5925	5947	5970	5992	6013	6037	6059	6081	6104
-4	5580	5602	5625	5647	5669	5691	5714	5736	5758	5781	5803	5825	5848	5870	5892	5914	5937	5959	5981	6004	6026	6048	6071	6093
-3	5570	5592	5614	5637	5659	5681	5703	5726	5750	5770	5792	5815	5837	5859	5881	5904	5926	5948	5971	5993	6015	6037	6060	6082
-2	5560	5582	5604	5626	5649	5671	5693	5715	5737	5760	5782	5804	5826	5849	5871	5893	5915	5938	5960	5982	6004	6026	6049	6071
-1	5550	5572	5594	5616	5639	5661	5683	5705	5727	5749	5772	5794	5816	5838	5860	5883	5905	5927	5949	5971	5993	6016	6038	6060
0	5540	5562	5584	5606	5628	5650	5673	5695	5717	5739	5761	5783	5805	5828	5850	5872	5894	5916	5938	5960	5983	6005	6027	6049
1	5530	5552	5574	5596	5618	5640	5662	5684	5707	5729	5751	5773	5795	5817	5839	5861	5883	5905	5928	5950	5972	5994	6016	6038
2	5520	5542	5564	5586	5608	5630	5652	5674	5696	5718	5740	5762	5784	5807	5829	5851	5873	5895	5917	5939	5961	5983	6005	6027
3	5510	5532	5554	5576	5598	5620	5642	5664	5686	5708	5730	5752	5774	5796	5818	5840	5862	5884	5906	5928	5950	5972	5994	6016
4	5500	5522	5544	5566	5588	5610	5632	5654	5676	5698	5720	5742	5764	5785	5807	5829	5851	5873	5895	5917	5939	5961	5983	6005
5	5490	5512	5533	5555	5577	5599	5621	5643	5665	5687	5709	5731	5753	5775	5797	5819	5841	5863	5885	5907	5928	5950	5972	5994
6	5480	5502	5523	5545	5567	5589	5611	5633	5655	5677	5699	5721	5742	5764	5786	5808	5830	5852	5874	5896	5918	5940	5961	5983
7	5470	5491	5513	5535	5557	5579	5601	5623	5645	5666	5688	5710	5732	5754	5776	5798	5819	5841	5863	5885	5907	5929	5951	5972
8	5460	5481	5503	5525	5547	5569	5590	5612	5634	5656	5678	5700	5721	5743	5765	5787	5809	5831	5852	5874	5896	5918	5940	5961
9	5450	5471	5493	5515	5537	5558	5580	5602	5624	5646	5667	5689	5711	5733	5754	5776	5798	5820	5842	5863	5885	5907	5929	5951
10	5439	5461	5483	5505	5526	5548	5570	5592	5613	5635	5657	5679	5700	5722	5744	5766	5787	5809	5831	5853	5874	5896	5918	5939
11	5429	5451	5473	5495	5516	5538	5560	5581	5603	5625	5646	5668	5690	5712	5733	5755	5777	5798	5820	5842	5863	5885	5907	5929
12	5419	5441	5463	5484	5506	5528	5549	5571	5593	5614	5636	5658	5679	5701	5723	5744	5766	5788	5809	5831	5853	5874	5896	5918
13	5409	5431	5453	5474	5496	5518	5539	5561	5582	5604	5626	5647	5669	5690	5712	5734	5755	5777	5799	5820	5842	5863	5885	5907
14	5399	5421	5443	5464	5486	5507	5529	5550	5572	5594	5615	5637	5658	5680	5702	5723	5745	5766	5788	5809	5831	5853	5874	5896
15	5389	5411	5432	5454	5476	5497	5519	5540	5562	5583	5605	5626	5648	5669	5691	5713	5734	5756	5777	5799	5820	5842	5863	5885
16	5379	5401	5422	5444	5465	5487	5508	5530	5551	5573	5594	5616	5637	5659	5680	5702	5723	5745	5766	5788	5809	5831	5852	5874
17	5368	5390	5411	5433	5454	5476	5497	5519	5540	5562	5583	5605	5626	5647	5669	5690	5712	5733	5755	5776	5798	5819	5841	5862

COMP. INLET TEMP. °F	27.4	27.5	27.6	27.7	27.8	27.9	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	29.0	29.1	29.2	29.3	29.4	29.5	29.6
-20	6273	6296	6318	6341	6364	6387	6410	6433	6456	6479	6501	6524	6547	6570	6593	6616	6639	6662	6685	6707	6730	6753	6776
-19	6264	6286	6309	6332	6355	6378	6401	6423	6446	6469	6492	6515	6538	6561	6583	6606	6629	6652	6675	6698	6720	6743	6766
-18	6254	6277	6300	6323	6346	6368	6391	6414	6437	6460	6482	6505	6528	6551	6574	6596	6619	6642	6665	6688	6711	6733	6756
-17	6245	6267	6290	6313	6336	6359	6381	6404	6427	6450	6473	6495	6518	6541	6564	6586	6609	6632	6655	6678	6700	6723	6746
-16	6236	6259	6281	6304	6327	6350	6372	6395	6418	6441	6463	6486	6509	6532	6554	6577	6600	6623	6645	6668	6691	6714	6736
-15	6227	6250	6272	6295	6318	6340	6363	6386	6409	6431	6454	6477	6499	6522	6545	6568	6590	6613	6636	6658	6681	6704	6727
-14	6217	6239	6262	6285	6308	6330	6353	6376	6398	6421	6444	6466	6489	6512	6534	6557	6580	6602	6625	6648	6670	6693	6716
-13	6207	6229	6252	6275	6297	6320	6343	6365	6388	6410	6433	6456	6478	6501	6524	6546	6569	6592	6614	6637	6660	6682	6705
-12	6197	6219	6242	6264	6287	6310	6332	6355	6377	6400	6423	6445	6468	6490	6513	6536	6558	6581	6603	6626	6649	6671	6694
-11	6187	6209	6232	6254	6277	6299	6322	6345	6367	6390	6412	6435	6457	6480	6502	6525	6548	6570	6593	6615	6638	6660	6683
-10	6176	6199	6222	6244	6267	6289	6312	6334	6357	6379	6402	6424	6447	6469	6492	6514	6537	6559	6582	6605	6627	6650	6672
-9	6166	6189	6211	6234	6256	6279	6301	6324	6346	6369	6391	6414	6436	6459	6481	6504	6526	6549	6571	6594	6616	6639	6661
-8	6156	6179	6201	6224	6246	6269	6291	6314	6336	6358	6381	6403	6426	6448	6471	6493	6516	6538	6561	6583	6605	6628	6650
-7	6146	6169	6191	6214	6236	6258	6281	6303	6326	6348	6371	6393	6415	6438	6460	6483	6505	6527	6550	6572	6595	6617	6640
-6	6136	6159	6181	6203	6226	6248	6271	6293	6315	6338	6360	6382	6405	6427	6450	6472	6494	6517	6539	6561	6584	6606	6629
-5	6126	6149	6171	6193	6216	6238	6260	6283	6305	6327	6350	6372	6394	6417	6439	6461	6484	6506	6528	6551	6573	6595	6618
-4	6115	6138	6160	6182	6204	6227	6249	6271	6294	6316	6338	6361	6383	6405	6427	6450	6472	6494	6517	6539	6561	6584	6606
-3	6104	6126	6149	6171	6193	6215	6238	6260	6282	6305	6327	6349	6371	6394	6416	6438	6460	6483	6505	6527	6549	6572	6594
-2	6093	6115	6138	6160	6182	6204	6226	6249	6271	6293	6315	6338	6360	6382	6404	6426	6449	6471	6493	6515	6538	6560	6582
-1	6082	6104	6127	6149	6171	6193	6215	6238	6260	6282	6304	6326	6348	6371	6393	6415	6437	6459	6482	6504	6526	6548	6570
0	6071	6093	6115	6138	6160	6182	6204	6226	6248	6270	6293	6315	6337	6359	6381	6403	6425	6448	6470	6492	6514	6536	6558
1	6060	6082	6104	6127	6149	6171	6193	6215	6237	6259	6281	6303	6325	6348	6370	6392	6414	6436	6458	6480	6502	6524	6547
2	6049	6071	6093	6115	6137	6160	6182	6204	6226	6248	6270	6292	6314	6336	6358	6380	6402	6424	6446	6468	6491	6513	6535
3	6038	6060	6082	6104	6126	6148	6170	6192	6214	6236	6259	6281	6303	6325	6347	6369	6391	6413	6435	6457	6479	6501	6523
4	6027	6049	6071	6093	6115	6137	6159	6181	6203	6225	6247	6269	6291	6313	6335	6357	6379	6401	6423	6445	6467	6489	6511
5	6016	6038	6060	6082	6104	6126	6148	6170	6192	6214	6236	6258	6280	6302	6323	6345	6367	6389	6411	6433	6455	6477	6499
6	6005	6027	6049	6071	6093	6115	6137	6159	6181	6202	6224	6246	6268	6290	6312	6334	6356	6378	6400	6421	6443	6465	6487
7	5994	6016	6038	6060	6082	6104	6126	6147	6169	6191	6213	6235	6257	6279	6300	6322	6344	6366	6388	6410	6432	6453	6475
8	5983	6005	6027	6049	6071	6092	6114	6136	6158	6180	6202	6223	6245	6267	6289	6311	6332	6354	6376	6398	6420	6442	6463
9	5972	5994	6016	6038	6059	6081	6103	6125	6147	6168	6190	6212	6234	6255	6277	6299	6321	6343	6364	6386	6408	6430	6452
10	5961	5983	6005	6026	6048	6070	6092	6113	6135	6157	6179	6200	6222	6244	6266	6287	6309	6331	6353	6374	6396	6418	6440
11	5950	5972	5994	6015	6037	6059	6080	6102	6124	6146	6167	6189	6211	6232	6254	6276	6298	6319	6341	6363	6384	6406	6428
12	5939	5961	5983	6004	6026	6048	6069	6091	6113	6134	6156	6178	6199	6221	6243	6264	6286	6308	6329	6351	6373	6394	6416
13	5928	5950	5972	5993	6015	6036	6058	6080	6101	6123	6145	6166	6188	6209	6231	6253	6274	6296	6318	6339	6361	6382	6404
14	5917	5937	5961	5982	6004	6025	6047	6068	6090	6112	6133	6155	6176	6198	6220	6241	6263	6284	6306	6327	6349	6371	6392
15	5906	5928	5950	5971	5993	6014	6036	6057	6079	6100	6122	6143	6165	6186	6208	6230	6251	6273	6294	6316	6337	6359	6380
16	5895	5917	5938	5960	5981	6003	6024	6046	6067	6089	6110	6132	6153	6175	6196	6218	6239	6261	6282	6304	6325	6347	6368
17	5884	5905	5926	5948	5969	5991	6012	6034	6055	6077	6098	6120	6141	6163	6184	6205	6227	6248	6270	6291	6313	6334	6356

COMP. INLET TEMP. °F	29.7	29.8	29.9	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.7	30.8	30.9	31.0	31.1	31.2	31.3	31.4	31.5	MAXIMUM ALLOWABLE S.F.C. #/HR/#F	COMP. INLET TEMP. °F
-20	6799	6822	6845	6868	6890	6913	6936	6959	6982	7005	7028	7051	7073	7096	7119	7142	7165	7188	7211	1.108	-20
-19	6789	6812	6835	6858	6880	6903	6926	6949	6972	6995	7017	7040	7063	7086	7109	7132	7154	7177	7200	1.107	-19
-18	6779	6802	6825	6847	6870	6893	6916	6939	6961	6984	7007	7030	7053	7076	7098	7121	7144	7167	7190	1.107	-18
-17	6769	6791	6814	6837	6860	6883	6905	6928	6951	6974	6996	7019	7042	7065	7088	7110	7133	7156	7179	1.106	-17
-16	6759	6782	6805	6827	6850	6873	6896	6918	6941	6964	6987	7009	7032	7055	7078	7100	7123	7146	7169	1.106	-16
-15	6749	6772	6795	6817	6840	6863	6886	6908	6931	6954	6976	6999	7022	7045	7067	7090	7113	7135	7158	1.105	-15
-14	6738	6761	6784	6806	6829	6852	6874	6897	6920	6942	6965	6988	7010	7033	7056	7078	7101	7124	7146	1.105	-14
-13	6727	6750	6773	6795	6818	6841	6863	6886	6909	6931	6954	6976	6999	7022	7044	7067	7090	7112	7135	1.105	-13
-12	6716	6739	6762	6784	6807	6829	6852	6875	6897	6920	6942	6965	6988	7010	7033	7055	7078	7101	7123	1.104	-12
-11	6706	6728	6751	6773	6796	6818	6841	6864	6886	6909	6931	6954	6976	6999	7021	7044	7067	7089	7112	1.104	-11
-10	6695	6717	6740	6762	6785	6807	6830	6853	6875	6897	6920	6942	6965	6987	7010	7033	7055	7078	7100	1.104	-10
-9	6684	6706	6729	6751	6774	6796	6819	6841	6864	6886	6909	6931	6954	6976	6999	7021	7044	7066	7089	1.104	-9
-8	6673	6695	6718	6740	6763	6785	6708	6830	6852	6875	6897	6920	6942	6965	6987	7010	7032	7055	7077	1.103	-8
-7	6662	6684	6707	6729	6752	6774	6796	6819	6841	6864	6886	6909	6931	6953	6976	6998	7021	7043	7065	1.103	-7
-6	6651	6673	6696	6718	6741	6763	6785	6808	6830	6852	6875	6897	6920	6942	6964	6987	7009	7031	7054	1.102	-6
-5	6640	6662	6685	6707	6729	6752	6774	6797	6819	6841	6864	6886	6908	6931	6953	6975	6998	7020	7042	1.102	-5
-4	6628	6650	6673	6695	6717	6740	6762	6784	6807	6829	6851	6874	6896	6918	6940	6963	6985	7007	7030	1.102	-4
-3	6616	6638	6661	6683	6705	6728	6750	6772	6794	6817	6839	6861	6883	6906	6928	6950	6972	6995	7017	1.101	-3
-2	6604	6626	6649	6671	6693	6715	6738	6760	6782	6804	6826	6849	6871	6893	6915	6938	6960	6982	7004	1.101	-2
-1	6592	6615	6637	6659	6681	6703	6726	6748	6770	6792	6814	6836	6859	6881	6903	6925	6947	6970	6992	1.100	-1
0	6581	6603	6625	6647	6669	6691	6713	6735	6758	6780	6802	6824	6846	6868	6890	6913	6935	6957	6979	1.100	0
1	6569	6591	6613	6635	6657	6679	6701	6723	6745	6768	6790	6812	6834	6856	6878	6900	6922	6944	6966	1.099	1
2	6557	6579	6601	6623	6645	6667	6689	6711	6733	6755	6777	6799	6821	6844	6866	6888	6910	6932	6954	1.098	2
3	6545	6567	6589	6611	6633	6655	6677	6699	6721	6743	6765	6787	6809	6831	6853	6875	6897	6919	6941	1.098	3
4	6533	6555	6577	6599	6621	6643	6665	6687	6709	6731	6753	6775	6797	6819	6841	6863	6885	6907	6929	1.097	4
5	6521	6543	6565	6587	6609	6631	6653	6675	6697	6718	6740	6762	6784	6806	6828	6850	6872	6894	6916	1.096	5
6	6509	6531	6553	6575	6597	6619	6641	6662	6684	6706	6728	6750	6772	6794	6816	6838	6860	6881	6903	1.096	6
7	6497	6519	6541	6563	6585	6607	6628	6650	6672	6694	6716	6738	6760	6781	6803	6825	6847	6869	6891	1.096	7
8	6485	6507	6529	6551	6573	6594	6616	6638	6660	6682	6703	6725	6747	6769	6791	6813	6834	6856	6878	1.095	8
9	6473	6495	6517	6539	6560	6582	6604	6626	6648	6669	6691	6713	6735	6756	6778	6800	6822	6844	6865	1.095	9
10	6461	6483	6505	6527	6548	6570	6592	6614	6635	6657	6679	6700	6722	6744	6766	6787	6809	6831	6853	1.095	10
11	6449	6471	6493	6515	6536	6558	6580	6601	6623	6645	6666	6688	6710	6732	6753	6775	6797	6818	6840	1.095	11
12	6438	6459	6481	6503	6524	6546	6568	6589	6611	6633	6654	6676	6698	6719	6741	6763	6784	6806	6827	1.094	12
13	6426	6447	6469	6491	6572	6534	6555	6577	6599	6620	6642	6664	6685	6707	6728	6750	6772	6793	6815	1.094	13
14	6414	6435	6457	6479	6500	6522	6543	6565	6586	6608	6630	6651	6673	6694	6716	6738	6759	6781	6802	1.093	14
15	6402	6423	6445	6467	6488	6510	6531	6553	6574	6596	6617	6639	6660	6682	6704	6725	6747	6768	6790	1.093	15
16	6390	6411	6433	6454	6476	6497	6519	6540	6562	6583	6605	6626	6648	6669	6691	6712	6734	6755	6777	1.093	16
17	6377	6399	6420	6442	6463	6484	6506	6527	6549	6570	6592	6613	6635	6656	6678	6699	6720	6742	6763	1.093	17

J4-23573

Figure 7-20. Performance Chart -23 7953

MODEL
J47-GE-23

7953 RPM

CHART CALCULATED FOR RAM DIFFERENTIAL PRESSURE 0 INCH H_2O

MAXIMUM ALLOWABLE EXHAUST GAS TEMPERATURE 690°C (1275°F)

VAPOR PRESSURE CORRECTION CHART

VAPOR PRESSURE ("HG)	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85	.90	.95	1.00	1.05	1.10	1.15	1.20
THRUST CORR. (SUBT)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
SFC CORR. (ADD.)	.001	.002	.002	.003	.004	.005	.005	.006	.007	.008	.008	.009	.010	.011	.011	.012	.013	.014	.014	.015	.016	.017	.017	.018
T.P.T. CORR. (SUBT.)	1	1	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	4	5	5	5	5	6

MINIMUM ALLOWABLE THRUST - POUNDS
COMPRESSOR INLET PRESSURE - INCHES HG ABSOLUTE

COMP. INLET TEMP. °F	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	26.0	26.1	26.2
94	4497	4515	4533	4551	4569	4587	4605	4623	4641	4659	4677	4695	4713
95	4485	4503	4521	4539	4557	4575	4593	4611	4629	4647	4665	4683	4700
96	4474	4491	4509	4527	4545	4563	4581	4599	4617	4635	4652	4670	4688
97	4462	4480	4498	4515	4533	4551	4569	4587	4605	4622	4640	4658	4676
98	4449	4467	4485	4503	4521	4538	4556	4574	4592	4609	4627	4645	4663
99	4437	4455	4472	4490	4507	4525	4543	4561	4579	4596	4614	4632	4650
100	4424	4442	4460	4477	4495	4513	4530	4548	4566	4583	4601	4619	4637
101	4413	4431	4449	4466	4484	4502	4519	4537	4555	4572	4590	4607	4625
102	4403	4420	4438	4455	4473	4491	4508	4526	4543	4561	4579	4596	4614
103	4391	4408	4426	4444	4461	4479	4496	4514	4531	4549	4566	4584	4602
104	4380	4398	4415	4433	4450	4468	4485	4503	4520	4538	4555	4573	4590
105	4369	4387	4404	4421	4439	4456	4474	4491	4509	4526	4544	4561	4579
106	4358	4376	4393	4411	4428	4445	4463	4480	4498	4515	4533	4550	4567
107	4347	4365	4382	4400	4417	4434	4452	4469	4486	4504	4521	4539	4556
108	4336	4353	4370	4388	4405	4422	4440	4457	4474	4492	4509	4526	4544
109	4325	4342	4359	4377	4394	4411	4429	4446	4463	4480	4498	4515	4532
110	4314	4331	4348	4366	4383	4400	4417	4435	4452	4469	4486	4504	4521
111	4303	4320	4338	4355	4372	4389	4406	4424	4441	4458	4475	4492	4510
112	4292	4309	4327	4344	4361	4378	4395	4412	4430	4447	4464	4481	4498
113	4281	4298	4315	4332	4349	4366	4383	4400	4417	4435	4452	4469	4486
114	4270	4287	4304	4321	4338	4355	4372	4389	4406	4423	4440	4457	4475
115	4259	4276	4293	4310	4327	4344	4361	4378	4395	4412	4429	4446	4463
116	4248	4265	4282	4299	4316	4333	4350	4367	4384	4401	4418	4435	4452
117	4237	4254	4271	4288	4305	4322	4339	4356	4373	4390	4406	4423	4440
118	4225	4242	4259	4276	4293	4310	4327	4344	4361	4377	4394	4411	4428
119	4215	4231	4248	4265	4282	4299	4316	4333	4349	4366	4383	4400	4417
120	4204	4221	4237	4254	4271	4288	4305	4321	4338	4355	4372	4389	4405
121	4193	4210	4226	4243	4260	4277	4293	4310	4327	4344	4360	4377	4394
122	4182	4199	4215	4232	4249	4266	4282	4299	4316	4332	4349	4366	4383
123	4170	4187	4204	4220	4237	4254	4270	4287	4304	4320	4337	4354	4370
124	4159	4176	4193	4209	4226	4243	4259	4276	4292	4309	4326	4342	4359
125	4149	4165	4182	4198	4215	4232	4248	4265	4281	4298	4314	4331	4348
126	4138	4154	4171	4187	4204	4220	4237	4253	4270	4287	4303	4320	4336
127	4127	4143	4160	4176	4193	4209	4226	4242	4259	4275	4292	4308	4325
128	4116	4132	4149	4165	4182	4198	4215	4231	4248	4264	4281	4297	4313
129	4105	4122	4138	4154	4171	4187	4204	4220	4236	4253	4269	4286	4302
130	4094	4111	4127	4143	4160	4176	4192	4209	4225	4241	4258	4274	4291

COMP. INLET TEMP. °F	26.3	26.4	26.5	26.6	26.7	26.8	26.9	27.0	27.1	27.2	27.3	27.4
94	4731	4749	4767	4785	4803	4821	4839	4857	4874	4892	4910	4928
95	4718	4736	4754	4772	4790	4808	4826	4844	4862	4880	4898	4916
96	4706	4724	4742	4760	4778	4795	4813	4831	4849	4867	4885	4903
97	4694	4712	4729	4747	4765	4783	4801	4819	4836	4854	4872	4890
98	4681	4698	4716	4734	4752	4770	4787	4805	4823	4841	4859	4876
99	4667	4685	4703	4721	4738	4756	4774	4792	4802	4827	4845	4862
100	4654	4672	4690	4707	4725	4743	4760	4778	4796	4813	4831	4849
101	4643	4660	4678	4696	4713	4731	4749	4766	4784	4802	4819	4837
102	4631	4649	4667	4684	4702	4719	4737	4755	4772	4790	4807	4825
103	4619	4637	4654	4672	4689	4707	4724	4742	4759	4777	4795	4812
104	4608	4625	4643	4660	4678	4695	4713	4730	4748	4765	4783	4800
105	4596	4614	4631	4649	4666	4683	4701	4718	4736	4753	4771	4788
106	4585	4602	4620	4637	4654	4672	4689	4707	4724	4742	4759	4776
107	4573	4591	4608	4625	4643	4660	4678	4695	4712	4730	4747	4764
108	4561	4578	4596	4613	4630	4648	4665	4682	4700	4717	4734	4752
109	4550	4567	4584	4602	4619	4636	4653	4671	4688	4705	4723	4740
110	4538	4555	4573	4590	4607	4624	4642	4659	4676	4693	4711	4728
111	4527	4544	4561	4578	4596	4613	4630	4647	4664	4682	4699	4716
112	4515	4533	4550	4567	4584	4601	4618	4635	4653	4670	4687	4704
113	4503	4520	4537	4554	4571	4589	4606	4623	4640	4657	4674	4691
114	4492	4509	4526	4543	4560	4577	4594	4611	4628	4645	4662	4679
115	4480	4497	4514	4531	4548	4565	4582	4599	4616	4633	4650	4667
116	4469	4486	4503	4520	4537	4554	4571	4588	4605	4622	4639	4656
117	4457	4474	4491	4508	4525	4542	4559	4576	4593	4610	4627	4644
118	4445	4462	4479	4496	4513	4529	4546	4563	4580	4597	4614	4631
119	4434	4450	4467	4484	4501	4518	4535	4552	4568	4585	4602	4619
120	4422	4439	4456	4473	4489	4506	4523	4540	4557	4573	4590	4607
121	4411	4427	4444	4461	4478	4494	4511	4528	4545	4561	4578	4595
122	4399	4416	4433	4449	4466	4483	4500	4516	4533	4550	4566	4583
123	4387	4404	4420	4437	4454	4470	4487	4504	4520	4537	4554	4570
124	4376	4392	4409	4425	4442	4459	4475	4492	4508	4525	4542	4558
125	4364	4381	4397	4414	4431	4447	4464	4480	4497	4513	4530	4547
126	4353	4369	4386	4402	4419	4435	4452	4469	4485	4502	4518	4535
127	4341	4358	4374	4391	4407	4424	4440	4457	4473	4490	4506	4523
128	4330	4346	4363	4379	4396	4412	4429	4445	4462	4478	4494	4511
129	4318	4335	4351	4368	4384	4400	4417	4433	4450	4466	4483	4499
130	4307	4323	4340	4356	4372	4389	4405	4422	4438	4454	4471	4487

COMP. INLET TEMP. °F	27.5	27.6	27.7	27.8	27.9	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8
94	4946	4964	4982	5000	5018	5036	5054	5072	5090	5108	5126	5144	5162	5180
95	4934	4951	4969	4987	5005	5023	5041	5059	5077	5095	5113	5131	5149	5167
96	4921	4939	4956	4974	4992	5010	5028	5046	5064	5082	5099	5117	5135	5153
97	4908	4926	4943	4961	4979	4997	5015	5033	5050	5068	5086	5104	5122	5140
98	4894	4912	4930	4947	4965	4983	5001	5019	5036	5054	5072	5090	5107	5125
99	4880	4898	4916	4933	4951	4969	4987	5004	5022	5040	5058	5075	5093	5111
100	4866	4884	4902	4919	4937	4955	4973	4990	5008	5026	5043	5061	5079	5096
101	4854	4872	4890	4907	4925	4943	4960	4978	4996	5013	5031	5049	5066	5084
102	4843	4860	4878	4895	4913	4931	4948	4966	4983	5001	5019	5036	5054	5071
103	4830	4847	4865	4882	4900	4917	4935	4953	4970	4988	5005	5023	5040	5058
104	4818	4835	4853	4870	4888	4905	4923	4940	4958	4975	4993	5010	5028	5045
105	4806	4823	4841	4858	4876	4893	4911	4928	4945	4963	4980	4998	5015	5033
106	4794	4811	4829	4846	4864	4881	4898	4916	4933	4951	4968	4985	5003	5020
107	4782	4799	4817	4834	4851	4869	4886	4903	4921	4938	4956	4973	4990	5008
108	4769	4786	4804	4821	4838	4856	4873	4890	4908	4925	4942	4960	4977	4994
109	4757	4774	4792	4809	4826	4844	4861	4878	4895	4913	4930	4947	4965	4982
110	4745	4762	4780	4797	4814	4831	4849	4866	4883	4900	4918	4935	4952	4969
111	4733	4750	4768	4785	4802	4819	4836	4854	4871	4888	4905	4922	4940	4957
112	4721	4738	4756	4773	4790	4807	4824	4841	4859	4876	4893	4910	4927	4944
113	4708	4725	4743	4760	4777	4794	4811	4828	4845	4862	4879	4897	4914	4931
114	4696	4713	4731	4748	4765	4782	4799	4816	4833	4850	4867	4884	4901	4918
115	4684	4701	4718	4735	4752	4770	4787	4804	4821	4838	4855	4872	4889	4906
116	4673	4690	4706	4723	4740	4757	4774	4791	4808	4825	4842	4859	4876	4893
117	4661	4677	4694	4711	4728	4745	4762	4779	4796	4813	4830	4847	4864	4881
118	4648	4665	4681	4698	4715	4732	4749	4766	4783	4800	4817	4833	4850	4867
119	4636	4653	4669	4686	4703	4720	4737	4754	4771	4787	4804	4821	4838	4855
120	4624	4641	4657	4674	4691	4708	4725	4741	4758	4775	4792	4809	4825	4842
121	4612	4629	4645	4662	4679	4696	4712	4729	4746	4763	4779	4796	4813	4830
122	4600	4617	4633	4650	4667	4684	4700	4717	4734	4750	4767	4784	4801	4817
123	4587	4604	4620	4637	4654	4670	4687	4704	4720	4737	4754	4770	4787	4804
124	4575	4592	4608	4625	4642	4658	4675	4691	4708	4725	4741	4758	4775	4791
125	4563	4580	4596	4613	4630	4646	4663	4679	4696	4712	4729	4746	4762	4779
126	4551	4568	4584	4601	4617	4634	4650	4667	4684	4700	4717	4733	4750	4766
127	4539	4556	4572	4589	4605	4622	4638	4655	4671	4688	4704	4721	4737	4754
128	4527	4544	4560	4577	4593	4610	4626	4642	4659	4675	4692	4708	4725	4741
129	4515	4532	4548	4565	4581	4597	4614	4630	4647	4663	4679	4696	4712	4729
130	4503	4520	4536	4552	4569	4585	4602	4618	4634	4651	4667	4683	4700	4716

COMP. INLET TEMP. °F	28.9	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.9	30.0	30.1
94	5198	5216	5234	5252	5270	5288	5306	5324	5342	5360	5378	5396	5414
95	5185	5202	5220	5238	5256	5274	5292	5310	5328	5346	5364	5382	5400
96	5171	5189	5207	5225	5243	5260	5278	5296	5314	5332	5350	5368	5386
97	5158	5175	5193	5211	5229	5247	5265	5282	5300	5318	5336	5354	5372
98	5143	5161	5179	5196	5214	5232	5250	5268	5285	5303	5321	5339	5356
99	5128	5146	5164	5182	5199	5217	5235	5253	5270	5288	5306	5324	5341
100	5114	5132	5149	5167	5185	5202	5220	5238	5255	5273	5291	5309	5326
101	5101	5119	5137	5154	5172	5190	5207	5225	5243	5260	5278	5296	5313
102	5089	5107	5124	5142	5159	5177	5195	5212	5230	5247	5265	5283	5300
103	5075	5093	5111	5128	5146	5163	5181	5198	5216	5233	5251	5269	5286
104	5063	5080	5098	5115	5133	5150	5168	5185	5203	5220	5238	5255	5273
105	5050	5068	5085	5103	5120	5138	5155	5172	5190	5207	5225	5242	5260
106	5038	5055	5073	5090	5107	5125	5142	5160	5177	5195	5212	5229	5247
107	5025	5043	5060	5077	5095	5112	5129	5147	5164	5182	5199	5216	5234
108	5012	5029	5046	5064	5081	5098	5116	5133	5150	5168	5185	5202	5220
109	4999	5016	5034	5051	5068	5086	5103	5120	5137	5155	5172	5189	5207
110	4987	5004	5021	5038	5055	5073	5090	5107	5124	5142	5159	5176	5193
111	4974	4991	5008	5026	5043	5060	5077	5094	5112	5129	5146	5163	5180
112	4961	4979	4996	5013	5030	5047	5064	5082	5099	5116	5133	5150	5167
113	4948	4965	4982	4999	5016	5033	5051	5068	5085	5102	5119	5136	5153
114	4935	4952	4969	4987	5004	5021	5038	5055	5072	5089	5106	5123	5140
115	4923	4940	4957	4974	4991	5008	5025	5042	5059	5076	5093	5110	5127
116	4910	4927	4944	4961	4978	4995	5012	5029	5046	5063	5080	5097	5114
117	4898	4915	4932	4948	4956	4982	4999	5016	5033	5050	5067	5084	5101
118	4884	4901	4918	4935	4952	4969	4985	5002	5019	5036	5053	5070	5087
119	4872	4888	4905	4922	4939	4956	4973	4990	5006	5023	5040	5057	5074
120	4859	4876	4893	4909	4926	4943	4960	4977	4993	5010	5027	5044	5061
121	4846	4863	4880	4897	4913	4930	494	4964	4981	4997	5014	5031	5048
122	4834	4851	4867	4884	4901	4918	4934	4951	4968	4984	5001	5018	5035
123	4820	4837	4854	4870	4887	4904	4920	4937	4954	4970	4987	5004	5020
124	4808	4824	4841	4858	4874	4891	4908	4924	4941	4957	4974	4991	5007
125	4795	4812	4829	4845	4862	4878	4895	4911	4928	4945	4961	4978	4994
126	4783	4799	4816	4832	4849	4865	4882	4899	4915	4932	4948	4965	4981
127	4770	4787	4803	4820	4836	4853	4869	4886	4902	4919	4935	4952	4968
128	4758	4774	4791	4807	4823	4840	4856	4873	4889	4906	4922	4939	4955
129	4745	4761	4778	4794	4811	4827	4844	4860	4876	4893	4909	4926	4942
130	4732	4749	4765	4782	4798	4814	4831	4847	4863	4880	4896	4913	4928

COMP. INLET TEMP. °F	30.2	30.3	30.4	30.5	30.6	30.7	30.8	30.9	31.0	31.1	31.2	31.3	31.4	31.5	MAXIMUM ALLOWABLE S.F.C. #/HR/#F	COMP. INLET TEMP. °F
94	5432	5450	5468	5486	5504	5522	5540	5558	5576	5594	5612	5629	5647	5665	1.098	94
95	5418	5436	5453	5471	5489	5507	5525	5543	5561	5579	5597	5615	5633	5651	1.099	95
96	5403	5421	5439	5457	5475	5493	5511	5529	5547	5564	5582	5600	5618	5636	1.099	96
97	5389	5407	5425	5443	5461	5479	5496	5514	5532	5550	5568	5586	5603	5621	1.099	97
98	5374	5392	5410	5428	5445	5463	5481	5499	5517	5534	5552	5570	5588	5605	1.100	98
99	5359	5377	5394	5412	5430	5448	5465	5483	5501	5519	5536	5554	5572	5590	1.100	99
100	5344	5362	5379	5397	5415	5432	5450	5468	5485	5503	5521	5538	5556	5574	1.100	100
101	5331	5348	5366	5384	5401	5419	5437	5454	5472	5490	5507	5525	5542	5560	1.100	101
102	5318	5335	5353	5370	5388	5406	5423	5441	5458	5476	5494	5511	5529	5546	1.101	102
103	5304	5321	5339	5356	5374	5391	5409	5426	5444	5462	5479	5497	5514	5532	1.101	103
104	5290	5308	5325	5342	5360	5378	5395	5413	5430	5448	5465	5483	5501	5518	1.102	104
105	5277	5295	5312	5330	5347	5365	5382	5400	5417	5434	5452	5469	5487	5504	1.102	105
106	5264	5282	5299	5316	5334	5351	5369	5386	5404	5421	5438	5456	5473	5491	1.103	106
107	5251	5268	5286	5303	5321	5338	5355	5373	5390	5407	5425	5442	5460	5477	1.104	107
108	5237	5254	5272	5289	5306	5324	5341	5358	5376	5393	5410	5428	5445	5462	1.104	108
109	5224	5241	5258	5276	5293	5310	5328	5345	5362	5379	5397	5414	5431	5449	1.105	109
110	5211	5228	5245	5262	5280	5297	5314	5331	5349	5366	5383	5400	5418	5435	1.106	110
111	5198	5215	5232	5249	5266	5284	5301	5318	5335	5352	5370	5387	5404	5421	1.107	111
112	5185	5202	5219	5236	5253	5270	5287	5305	5322	5339	5356	5373	5390	5408	1.108	112
113	5170	5187	5205	5222	5239	5256	5273	5290	5307	5324	5341	5359	5376	5393	1.108	113
114	5157	5174	5191	5208	5225	5243	5260	5277	5294	5311	5328	5345	5362	5379	1.109	114
115	5144	5161	5178	5195	5212	5229	5246	5263	5280	5297	5314	5331	5348	5365	1.110	115
116	5131	5148	5165	5182	5199	5216	5233	5250	5267	5284	5301	5318	5335	5352	1.110	116
117	5118	5135	5152	5169	5186	5203	5219	5236	5253	5270	5287	5304	5321	5338	1.110	117
118	5104	5121	5137	5145	5171	5188	5205	5222	5239	5256	5273	5289	5306	5323	1.111	118
119	5091	5107	5124	5141	5158	5175	5192	5209	5225	5242	5259	5276	5293	5310	1.111	119
120	5078	5094	5111	5128	5145	5162	5178	5195	5212	5229	5246	5262	5279	5296	1.111	120
121	5064	5081	5098	5115	5131	5148	5165	5182	5198	5215	5232	5249	5265	5282	1.112	121
122	5051	5068	5085	5101	5118	5135	5152	5168	5185	5202	5218	5235	5252	5269	1.113	122
123	5037	5054	5070	5087	5104	5120	5137	5154	5171	5187	5204	5221	5237	5254	1.113	123
124	5024	5041	5057	5074	5091	5107	5124	5140	5157	5174	5190	5207	5224	5240	1.114	124
125	5011	5028	5044	5061	5077	5094	5110	5127	5144	5160	5177	5193	5210	5226	1.115	125
126	4998	5014	5031	5047	5064	5080	5097	5114	5130	5147	5163	5180	5196	5213	1.115	126
127	4985	5001	5018	5034	5051	5067	5084	5100	5117	5133	5150	5166	5183	5199	1.116	127
128	4972	4988	5004	5021	5037	5054	5070	5087	5103	5120	5136	5153	5169	5185	1.116	128
129	4958	4975	4991	5008	5024	5040	5057	5073	5090	5106	5122	5139	5155	5172	1.117	129
130	4945	4962	4978	4994	5011	5027	5043	5060	5076	5093	5109	5125	5142	5158	1.117	130

J47-23577

Figure 7-23. Performance Chart -23 7953

MODEL J47-GE-23

7953 RPM

CHART CALCULATED FOR RAM DIFFERENTIAL PRESSURE O INCH H_2O

MAXIMUM ALLOWABLE EXHAUST GAS TEMPERATURE 690°C (1275°F)

VAPOR PRESSURE CORRECTION CHART

VAPOR PRESSURE ("HG)	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85	.90	.95	1.00	1.05	1.10	1.15	1.20
THRUST CORR. (SUBT)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
SFC CORR. (ADD.)	.001	.002	.002	.003	.004	.005	.005	.006	.007	.008	.00[illegible]	.009	.010	.011	.011	.012	.013	.014	.014	.015	.016	.017	.017	.018
T.P.T. CORR. (SUBT.)	1	1	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	4	5	5	5	5	6

MINIMUM ALLOWABLE THRUST - POUNDS
COMPRESSOR INLET PRESSURE - INCHES HG ABSOLUTE

COMP. INLET TEMP. °F	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	26.0	26.1	26.2	26.3	26.4	26.5	26.6	26.7	26.8
56	4952	4971	4991	5011	5031	5050	5070	5090	5110	5130	5149	5169	5189	5209	5229	5248	5268	5288	5308
57	4941	4960	4980	5000	5020	5039	5059	5079	5099	5118	5138	5158	5178	5197	5217	5237	5257	5276	5296
58	4930	4950	4969	4989	5009	5028	5048	5068	5087	5107	5127	5147	5166	5186	5206	5225	5245	5265	5285
59	4918	4938	4957	4977	4997	5016	5036	5056	5075	5095	5115	5134	5154	5174	5193	5213	5233	5252	5272
60	4906	4926	4946	4965	4985	5004	5024	5044	5063	5083	5103	5122	5142	5161	5181	5201	5220	5240	5259
61	4895	4914	4934	4953	4973	4993	5012	5032	5051	5071	5090	5110	5129	5149	5169	5188	5208	5227	5247
62	4883	4903	4922	4942	4961	4981	5000	5020	5039	5059	5078	5098	5117	5137	5156	5176	5195	5215	5234
63	4871	4891	4910	4930	4949	4969	4988	5008	5027	5047	5066	5085	5105	5124	5144	5163	5183	5202	5222
64	4860	4879	4898	4918	4937	4957	4976	4996	5015	5034	5054	5073	5093	5112	5132	5151	5170	5190	5209
65	4848	4867	4887	4906	4925	4945	4964	4984	5003	5022	5042	5061	5080	5100	5119	5139	5158	5177	5197
66	4836	4856	4875	4894	4914	4933	4953	4972	4991	5010	5030	5049	5068	5088	5107	5126	5146	5165	5184
67	4825	4844	4863	4882	4902	4921	4940	4959	4979	4998	5017	5037	5056	5075	5094	5114	5133	5152	5172
68	4813	4832	4851	4871	4890	4909	4928	4947	4967	4986	5005	5024	5044	5063	5082	5101	5121	5140	5159
69	4801	4820	4839	4859	4878	4897	4916	4935	4955	4974	4993	5012	5031	5051	5070	5089	5108	5127	5147
70	4789	4809	4828	4847	4866	4885	4904	4923	4943	4961	4981	5000	5019	5038	5057	5077	5096	5115	5134
71	4778	4797	4816	4835	4854	4873	4892	4911	4930	4950	4969	4988	5007	5026	5045	5064	5083	5102	5121
72	4765	4784	4803	4822	4841	4860	4879	4899	4918	4937	4956	4975	4994	5013	5032	5051	5070	5089	5108
73	4754	4773	4792	4811	4830	4849	4868	4887	4906	4925	4944	4963	4982	5001	5020	5039	5058	5077	5096
74	4741	4760	4779	4798	4817	4836	4855	4874	4893	4912	4931	4949	4968	4987	5006	5025	5044	5063	5082
75	4728	4747	4766	4785	4804	4823	4842	4861	4880	4899	4917	4936	4955	4974	4993	5012	5031	5050	5069
76	4716	4735	4754	4772	4791	4810	4829	4848	4867	4886	4904	4923	4942	4961	4980	4999	5018	5036	5055
77	4703	4722	4741	4760	4779	4797	4816	4835	4854	4873	4891	4910	4929	4948	4967	4985	5004	5023	5042
78	4692	4710	4729	4748	4767	4785	4804	4823	4842	4860	4879	4898	4917	4936	4954	4973	4992	5011	5029
79	4679	4698	4717	4735	4754	4773	4791	4810	4829	4847	4866	4885	4904	4922	4941	4960	4978	4997	5016
80	4667	4686	4705	4723	4742	4761	4779	4798	4817	4835	4854	4873	4891	4910	4929	4947	4966	4985	5003
81	4655	4674	4692	4711	4729	4748	4767	4785	4804	4822	4841	4860	4878	4897	4915	4934	4953	4971	4990
82	4642	4661	4680	4698	4717	4735	4754	4772	4791	4809	4828	4847	4865	4884	4902	4921	4939	4958	4976
83	4630	4648	4667	4685	4704	4722	4741	4759	4778	4796	4815	4833	4852	4870	4889	4907	4926	4944	4963
84	4618	4637	4655	4673	4692	4710	4729	4747	4766	4784	4803	4821	4840	4858	4877	4895	4913	4932	4950
85	4606	4625	4643	4662	4680	4698	4717	4735	4754	4772	4791	4809	4827	4846	4864	4883	4901	4919	4938
86	4594	4612	4631	4649	4667	4686	4704	4722	4741	4759	4778	4796	4814	4833	4851	4869	4888	4906	4924
87	4581	4600	4618	4636	4655	4673	4691	4710	4728	4746	4765	4783	4801	4819	4838	4856	4874	4893	4911
88	4569	4587	4605	4624	4642	4660	4678	4697	4715	4733	4751	4770	4788	4806	4824	4843	4861	4879	4898
89	4557	4575	4594	4612	4630	4648	4666	4685	4703	4721	4739	4757	4776	4794	4812	4830	4849	4867	4885
90	4545	4564	4582	4600	4618	4636	4654	4673	4691	4709	4727	4745	4763	4782	4800	4818	4836	4854	4872
91	4533	4551	4569	4587	4605	4624	4642	4660	4678	4696	4714	4732	4750	4768	4787	4805	4823	4841	4859
92	4520	4538	4557	4575	4593	4611	4629	4647	4665	4683	4701	4719	4737	4755	4773	4791	4810	4828	4846
93	4509	4527	4545	4563	4581	4599	4617	4635	4653	4671	4689	4707	4725	4743	4761	4779	4797	4815	4833

COMP. INLET TEMP. °F	26.9	27.0	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	28.0	28.1
56	5328	5347	5367	5387	5407	5427	5446	5466	5486	5506	5525	5545	5565
57	5316	5336	5355	5375	5395	5415	5434	5454	5474	5494	5513	5533	5553
58	5304	5324	5344	5363	5383	5403	5422	5442	5462	5482	5501	5521	5541
59	5292	5311	5331	5351	5370	5390	5410	5429	5449	5469	5488	5508	5528
60	5279	5299	5318	5338	5357	5377	5397	5416	5436	5456	5475	5495	5514
61	5266	5286	5306	5325	5345	5364	5384	5403	5423	5443	5462	5482	5501
62	5254	5273	5293	5312	5332	5351	5371	5390	5410	5430	5449	5469	5488
63	5241	5261	5280	5300	5319	5339	5358	5378	5397	5417	5436	5455	5475
64	5229	5248	5268	5287	5306	5326	5345	5365	5384	5404	5423	5442	5462
65	5216	5236	5255	5274	5294	5313	5332	5352	5371	5391	5410	5429	5449
66	5204	5223	5242	5262	5281	5300	5320	5339	5358	5377	5397	5416	5435
67	5191	5210	5229	5249	5268	5287	5307	5326	5345	5364	5384	5403	5422
68	5178	5198	5217	5236	5255	5275	5294	5313	5332	5351	5371	5390	5409
69	5166	5185	5204	5223	5243	5262	5281	5300	5319	5338	5358	5377	5396
70	5153	5172	5191	5211	5230	5249	5268	5287	5306	5325	5345	5364	5383
71	5141	5160	5179	5198	5217	5236	5255	5274	5293	5312	5332	5351	5370
72	5127	5146	5165	5184	5203	5222	5241	5260	5279	5299	5318	5337	5356
73	5115	5134	5153	5172	5191	5210	5229	5248	5267	5286	5305	5324	5343
74	5101	5120	5139	5158	5177	5196	5215	5234	5253	5272	5291	5310	5328
75	5088	5106	5125	5144	5163	5182	5201	5220	5239	5258	5277	5295	5314
76	5074	5093	5112	5131	5149	5168	5187	5206	5225	5244	5263	5281	5300
77	5061	5079	5098	5117	5136	5155	5173	5192	5211	5230	5249	5267	5286
78	5048	5067	5086	5104	5123	5142	5161	5179	5198	5217	5236	5254	5273
79	5034	5053	5072	5091	5109	5128	5147	5165	5184	5203	5222	5240	5259
80	5022	5041	5059	5078	5097	5115	5134	5152	5171	5190	5208	5227	5246
81	5008	5027	5046	5064	5083	5101	5120	5139	5157	5176	5195	5213	5232
82	4995	5014	5032	5051	5069	5088	5106	5125	5143	5162	5181	5199	5218
83	4981	5000	5018	5037	5055	5074	5092	5111	5129	5148	5165	5185	5204
84	4969	4987	5006	5024	5043	5061	5080	5098	5117	5135	5153	5172	5190
85	4956	4975	4993	5011	5030	5048	5067	5085	5104	5122	5140	5159	5177
86	4943	4961	4980	4998	5016	5035	5053	5071	5090	5108	5126	5145	5163
87	4929	4948	4966	4984	5003	5021	5039	5058	5076	5094	5112	5131	5149
88	4916	4934	4952	4971	4989	5007	5025	5044	5062	5080	5098	5117	5135
89	4903	4921	4940	4958	4976	4994	5013	5031	5049	5067	5085	5104	5122
90	4891	4909	4927	4945	4963	4981	5000	5018	5036	5054	5072	5091	5109
91	4877	4895	4913	4932	4950	4968	4986	5004	5022	5040	5058	5077	5095
92	4864	4882	4900	4918	4936	4954	4972	4990	5008	5026	5044	5062	5081
93	4851	4869	4887	4905	4923	4941	4959	4977	4995	5013	5031	5049	5067

COMP. INLET TEMP. °F	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	29.0	29.1	29.2	29.3	29.4	29.5	29.6
56	5585	5605	5624	5644	5664	5684	5704	5723	5743	5763	5783	5803	5822	5842	5862
57	5573	5592	5612	5632	5652	5671	5691	5711	5731	5750	5770	5790	5810	5829	5849
58	5560	5580	5600	5620	5629	5659	5679	5698	5718	5738	5758	5777	5797	5817	5836
59	5547	5567	5587	6606	5626	5645	5665	5685	5704	5724	5744	5763	5783	5803	5822
60	5534	5554	5573	5593	5612	5632	5652	5671	5691	5710	5730	5750	5769	5789	5809
61	5521	5540	5560	5580	5599	5619	5638	5658	5677	5697	5716	5736	5756	5775	5795
62	5508	5527	5547	5566	5586	5605	5625	5644	5664	5683	5703	5722	5742	5761	5781
63	5494	5514	5533	5553	5572	5592	5611	5631	5650	5670	5689	5709	5728	5748	5767
64	5481	5501	5520	5539	5559	5578	5598	5617	5637	5656	5675	5695	5714	5734	5753
65	5468	5487	5507	5526	5546	5565	5584	5604	5623	5642	5662	5681	5701	5720	5739
66	5455	5474	5493	5513	5532	5551	5571	5590	5609	5629	5648	5667	5687	5706	5725
67	5442	5461	5480	5499	5519	5538	5557	5577	5596	5615	5634	5654	5673	5692	5712
68	5428	5448	5467	5486	5505	5525	5544	5563	5582	5602	5621	5640	5659	5679	5698
69	5415	5434	5454	5473	5492	5511	5530	5550	5569	5588	5607	5626	5646	5665	5684
70	5402	5421	5440	5459	5479	5498	5517	5536	5555	5574	5593	5613	5632	5651	5670
71	5389	5408	5427	5446	5465	5484	5503	5523	5542	5561	5580	5599	5618	5637	5656
72	5375	5394	5413	5432	5451	5470	5489	5508	5527	5546	5565	5584	5603	5622	5641
73	5362	5381	5400	5419	5438	5457	5476	5495	5514	5533	5552	5571	5590	5609	5628
74	5347	5366	5385	5404	5423	5442	5461	5480	5499	5518	5537	5556	5575	5594	5613
75	5333	5352	5371	5390	5409	5428	5447	5466	5484	5503	5522	5541	5560	5579	5598
76	5319	5338	5357	5376	5395	5413	5432	5451	5470	5489	5508	5526	5545	5564	5583
77	5305	5324	5343	5361	5380	5399	5418	5437	5455	5474	5493	5512	5531	5549	5568
78	5292	5311	5329	5348	5367	5386	5404	5423	5442	5461	5479	5498	5517	5536	5554
79	5278	5296	5315	5334	5352	5371	5390	5409	5427	5446	5465	5483	5502	5521	5539
80	5264	5283	5302	5320	5339	5358	5376	5395	5414	5432	5451	5470	5488	5507	5526
81	5250	5269	5288	5306	5325	5343	5362	5381	5399	5418	5436	5455	5474	5492	5511
82	5236	5255	5273	5292	5310	5329	5348	5366	5385	5403	5422	5440	5459	5477	5496
83	5222	5241	5259	5278	5296	5315	5333	5352	5370	5389	5407	5426	5444	5463	5481
84	5209	5227	5246	5264	5283	5301	5320	5338	5357	5375	5393	5412	5430	5449	5467
85	5196	5214	5232	5251	5269	5288	5306	5325	5343	5361	5380	5398	5417	5435	5453
86	5182	5200	5218	5237	5255	5273	5292	5310	5328	5347	5365	5384	5402	5420	5439
87	5167	5186	5204	5222	5241	5259	5277	5296	5314	5332	5351	5369	5387	5405	5424
88	5153	5171	5190	5208	5226	5245	5263	5281	5299	5318	5336	5354	5372	5391	5409
89	5140	5158	5176	5195	5213	5231	5249	5268	5286	5304	5322	5340	5359	5377	5395
90	5127	5145	5163	5181	5200	5218	5236	5254	5272	5290	5309	5327	5345	5363	5381
91	5113	5131	5149	5167	5185	5203	5221	5240	5258	5276	5294	5312	5330	5348	5366
92	5099	5117	5135	5153	5171	5189	5207	5225	5243	5261	5279	5297	5315	5334	5352
93	5085	5103	5121	5140	5158	5176	5194	5212	5230	5248	5266	5284	5302	5320	5338

COMP. INLET TEMP. °F	29.7	29.8	29.9	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.7	30.8	30.9
56	5882	5902	5921	5941	5961	5981	6001	6020	6040	6060	6080	6099	6119
57	5869	5889	5908	5928	5948	5968	5987	6007	6027	6047	6066	6086	6106
58	5856	5876	5895	5915	5935	5955	5974	5994	6014	6033	6053	6073	6092
59	5842	5862	5881	5901	5921	5940	5960	5980	5999	6019	6039	6058	6078
60	5828	5848	5867	5887	5907	5926	5946	5965	5985	6005	6024	6044	6064
61	5814	5834	5853	5873	5893	5912	5932	5951	5971	5990	6010	6030	6049
62	5800	5820	5839	5859	5878	5898	5918	5937	5957	5976	5996	6015	6034
63	5786	5806	5825	5845	5864	5884	5903	5923	5942	5962	5981	6001	6020
64	5773	5792	5811	5831	5850	5870	5889	5909	5928	5947	5967	5986	6006
65	5759	5778	5797	5817	5836	5856	5875	5894	5914	5933	5953	5972	5991
66	5745	5764	5783	5803	5822	5841	5861	5880	5899	5919	5939	5957	5977
67	5731	5750	5769	5789	5808	5827	5847	5866	5885	5904	5924	5943	5962
68	5717	5736	5755	5775	5794	5813	5832	5852	5871	5890	5909	5929	5948
69	5703	5722	5742	5761	5780	5799	5818	5837	5857	5876	5895	5914	5933
70	5689	5708	5728	5747	5766	5785	5804	5823	5842	5862	5881	5900	5919
71	5675	5694	5714	5733	5752	5771	5790	5809	5828	5847	5866	5885	5904
72	5660	5680	5699	5718	5737	5756	5775	5794	5813	5832	5851	5870	5889
73	5647	5666	5685	5704	5723	5742	5761	5780	5799	5818	5837	5856	5875
74	5632	5651	5670	5689	5708	5726	5745	5764	5783	5802	5821	5840	5859
75	5617	5636	5655	5673	5692	5711	5730	5749	5768	5787	5806	5825	5844
76	5602	5621	5640	5658	5677	5696	5715	5734	5753	5772	5790	5809	5828
77	5587	5606	5625	5643	5662	5681	5700	5719	5737	5756	5775	5794	5813
78	5573	5592	5611	5629	5648	5667	5686	5704	5723	5742	5761	5779	5798
79	5558	5577	5596	5614	5633	5652	5670	5689	5708	5727	5745	5764	5783
80	5544	5563	5582	5600	5619	5638	5656	5675	5694	5712	5731	5750	5768
81	5529	5548	5567	5585	5604	5622	5641	5660	5678	5697	5715	5734	5753
82	5515	5533	5552	5570	5589	5607	5626	5644	5663	5682	5700	5719	5737
83	5500	5518	5537	5555	5574	5592	5611	5629	5648	5666	5685	5703	5722
84	5486	5504	5523	5541	5560	5578	5596	5615	5633	5652	5670	5689	5707
85	5472	5490	5509	5527	5545	5564	5582	5601	5619	5638	5656	5674	5693
86	5457	5475	5494	5512	5530	5549	5567	5586	5604	5622	5641	5659	5677
87	5442	5460	5479	5497	5515	5534	5552	5570	5589	5607	5625	5644	5662
88	5427	5445	5464	5482	5500	5518	5537	5555	5573	5592	5610	5628	5646
89	5413	5431	5450	5468	5486	5504	5523	5541	5559	5577	5595	5614	5632
90	5399	5418	5436	5454	5472	5490	5508	5527	5545	5563	5581	5599	5617
91	5385	5403	5421	5439	5457	5475	5493	5511	5530	5548	5566	5584	5602
92	5370	5388	5406	5424	5442	5460	5478	5496	5514	5532	5550	5568	5586
93	5356	5374	5392	5410	5428	5446	5464	5482	5500	5518	5536	5554	5572

COMP. INLET TEMP. °F	31.0	31.1	31.2	31.3	31.4	31.5	MAXIMUM ALLOWABLE S.F.C. #/HR/#F	COMP. INLET TEMP. °F
56	6139	6159	6179	6198	6218	6238	1.090	56
57	6126	6145	6165	6185	6205	6224	1.090	57
58	6112	6132	6152	6171	6191	6211	1.090	58
59	6098	6117	6137	6157	6176	6196	1.090	59
60	6083	6103	6122	6142	6162	6181	1.090	60
61	6069	6088	6108	6127	6147	6166	1.090	61
62	6054	6074	6093	6113	6132	6151	1.090	62
63	6040	6059	6079	6098	6118	6137	1.090	63
64	6025	6045	6064	6083	6103	6122	1.090	64
65	6011	6030	6049	6069	6088	6108	1.090	65
66	5996	6015	6035	6054	6073	6093	1.090	66
67	5982	6001	6020	6039	6059	6078	1.090	67
68	5967	5986	6006	6025	6044	6063	1.090	68
69	5953	5972	5991	6010	6029	6049	1.090	69
70	5938	5957	5976	5996	6015	6034	1.090	70
71	5924	5943	5962	5981	6000	6019	1.090	71
72	5908	5927	5946	5965	5984	6003	1.091	72
73	5894	5913	5931	5951	5970	5989	1.091	73
74	5878	5897	5916	5935	5954	5973	1.092	74
75	5862	5881	5900	5919	5938	5957	1.092	75
76	5847	5866	5885	5904	5922	5941	1.092	76
77	5831	5850	5869	5888	5907	5925	1.092	77
78	5817	5836	5854	5873	5892	5911	1.093	78
79	5801	5820	5839	5857	5876	5895	1.093	79
80	5787	5805	5824	5843	5861	5880	1.093	80
81	5771	5790	5809	5827	5846	5864	1.093	81
82	5756	5774	5793	5811	5830	5849	1.093	82
83	5740	5759	5777	5796	5814	5833	1.094	83
84	5726	5744	5763	5781	5800	5818	1.094	84
85	5711	5730	5748	5766	5785	5803	1.094	85
86	5696	5714	5732	5751	5769	5787	1.094	86
87	5680	5698	5717	5735	5753	5772	1.094	87
88	5665	5683	5701	5719	5738	5756	1.095	88
89	5650	5668	5686	5705	5723	5741	1.095	89
90	5636	5654	5672	5690	5708	5726	1.095	90
91	5620	5638	5656	5674	5693	5711	1.096	91
92	5605	5623	5641	5659	5677	5695	1.097	92
93	5590	5608	5626	5644	5662	5680	1.097	93

J47-23580

Figure 7-22. Performance Chart -23 7953

CHART CALCULATED FOR RAM DIFFERENTIAL PRESSURE O INCH H_2O

MAXIMUM ALLOWABLE EXHAUST GAS TEMPERATURE 690°C (1275°F)

VAPOR PRESSURE CORRECTION CHART

VAPOR PRESSURE ("HG)	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85	.90	.95	1.00	1.05	1.10	1.15	1.20
THRUST CORR. (SUBT)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
SFC CORR. (ADD.)	.001	.002	.002	.003	.004	.005	.005	.006	.007	.008	.008	.009	.010	.011	.011	.012	.013	.014	.014	.015	.016	.017	.017	.018
T.P.T. CORR. (SUBT.)	1	1	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	4	5	5	5	5	6

MINIMUM ALLOWABLE THRUST - POUNDS
COMPRESSOR INLET PRESSURE INCHES HG ABSOLUTE

COMP. INLET TEMP. °F	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	26.0	26.1	26.2	26.3	26.4	26.5	26.6	26.7	26.8
94	4568	4586	4605	4623	4641	4659	4678	4696	4714	4732	4751	4769	4787	4805	4824	4842	4860	4878	4897
95	4556	4575	4593	4611	4629	4647	4666	4684	4702	4720	4738	4757	4775	4793	4811	4829	4848	4866	4884
96	4545	4563	4581	4599	4617	4635	4654	4672	4690	4708	4726	4744	4763	4781	4799	4817	4835	4853	4872
97	4533	4551	4569	4587	4605	4624	4642	4660	4678	4696	4714	4732	4750	4768	4787	4805	4823	4841	4859
98	4521	4539	4557	4575	4593	4612	4630	4648	4666	4684	4702	4720	4738	4756	4774	4792	4810	4828	4847
99	4510	4528	4546	4564	4582	4600	4618	4636	4654	4672	4690	4708	4726	4744	4762	4780	4798	4816	4834
100	4498	4516	4534	4552	4570	4588	4606	4624	4642	4660	4678	4696	4714	4732	4750	4767	4785	4803	4821
101	4486	4504	4522	4540	4558	4576	4594	4612	4630	4647	4665	4683	4701	4719	4737	4755	4773	4791	4809
102	4474	4492	4510	4528	4546	4564	4582	4600	4617	4635	4653	4671	4689	4707	4725	4743	4761	4778	4796
103	4463	4481	4498	4516	4534	4552	4570	4588	4605	4623	4641	4659	4677	4695	4712	4730	4748	4766	4784
104	4451	4469	4487	4504	4522	4540	4558	4576	4593	4611	4629	4647	4665	4682	4700	4718	4736	4753	4771
105	4439	4457	4475	4493	4510	4528	4546	4564	4581	4599	4617	4634	4652	4670	4688	4705	4723	4741	4759
106	4428	4445	4463	4481	4498	4516	4534	4551	4569	4587	4605	4622	4640	4658	4675	4693	4711	4728	4746
107	4416	4434	4451	4469	4487	4504	4522	4539	4557	4575	4592	4610	4628	4645	4663	4681	4698	4716	4734
108	4405	4423	4440	4458	4476	4493	4511	4528	4546	4564	4581	4599	4616	4634	4652	4669	4687	4704	4722
109	4393	4411	4429	4446	4464	4481	4499	4516	4534	4551	4569	4587	4604	4622	4639	4657	4674	4692	4710
110	4382	4399	4417	4434	4452	4469	4487	4504	4522	4539	4557	4574	4592	4609	4627	4644	4662	4679	4697
111	4370	4387	4405	4422	4440	4457	4475	4492	4510	4527	4545	4562	4580	4597	4615	4632	4649	4667	4684
112	4358	4376	4393	4411	4428	4445	4463	4480	4498	4515	4533	4550	4567	4585	4602	4620	4637	4654	4672
113	4347	4364	4381	4399	4416	4433	4451	4468	4486	4503	4520	4538	4555	4572	4590	4607	4625	4642	4659
114	4335	4352	4370	4387	4404	4422	4439	4456	4474	4491	4508	4526	4543	4560	4577	4595	4612	4629	4647
115	4323	4340	4358	4375	4392	4410	4427	4444	4461	4479	4496	4513	4531	4548	4565	4582	4600	4617	4634
116	4312	4330	4347	4364	4381	4398	4416	4433	4450	4467	4485	4502	4519	4536	4554	4571	4588	4605	4623
117	4301	4319	4336	4353	4370	4387	4405	4422	4439	4456	4473	4491	4508	4525	4542	4559	4577	4594	4611
118	4291	4308	4325	4342	4359	4376	4394	4411	4428	4445	4462	4479	4496	4514	4531	4538	4565	4582	4599
119	4280	4297	4314	4331	4348	4365	4382	4399	4417	4434	4451	4468	4485	4502	4519	4536	4553	4571	4588
120	4269	4286	4303	4320	4337	4354	4371	4388	4405	4423	4440	4457	4474	4491	4508	4525	4542	4559	4576
121	4258	4275	4292	4309	4326	4343	4360	4377	4394	4411	4428	4445	4462	4479	4496	4513	4530	4547	4564
122	4247	4264	4281	4298	4315	4332	4349	4366	4383	4400	4417	4434	4451	4468	4485	4502	4519	4536	4553
123	4237	4254	4271	4288	4305	4322	4339	4356	4373	4390	4406	4423	4440	4457	4474	4491	4508	4525	4542
124	4226	4243	4260	4277	4294	4311	4328	4345	4361	4378	4395	4412	4429	4446	4463	4480	4497	4513	4530
125	4215	4232	4249	4266	4283	4300	4317	4333	4350	4367	4384	4401	4418	4434	4451	4468	4485	4502	4519
126	4205	4221	4238	4255	4272	4289	4305	4322	4339	4356	4373	4389	4406	4423	4440	4457	4473	4490	4507
127	4194	4210	4227	4244	4261	4278	4294	4311	4328	4345	4361	4378	4395	4412	4428	4445	4462	4479	4495
128	4183	4200	4216	4233	4250	4266	4283	4300	4317	4333	4350	4367	4383	4400	4417	4434	4450	4467	4484
129	4172	4189	4205	4222	4239	4255	4272	4289	4305	4322	4339	4355	4372	4389	4405	4422	4439	4456	4472
130	4161	4178	4194	4211	4228	4244	4261	4278	4294	4311	4327	4344	4361	4377	4394	4411	4427	4444	4460

COMP. INLET TEMP. °F	26.9	27.0	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8
94	4915	4933	4951	4970	4988	5006	5025	5043	5061	5079	5098	5116	5134	5152	5171	5189	5207	5225	5244	5262
95	4902	4921	4939	4957	4975	4993	5012	5030	5048	5066	5084	5103	5121	5139	5157	5176	5194	5212	5230	5248
96	4890	4908	4926	4944	4962	4981	4999	5017	5035	5053	5071	5090	5108	5126	5144	5162	5181	5199	5217	5235
97	4877	4895	4913	4932	4950	4968	4986	5004	5022	5040	5058	5077	5095	5113	5131	5149	5167	5185	5203	5221
98	4865	4883	4901	4919	4937	4955	4973	4991	5009	5027	5045	5063	5081	5101	5118	5136	5154	5172	5190	5208
99	4852	4870	4888	4906	4924	4942	4960	4978	4996	5014	5032	5050	5068	5086	5104	5122	5140	5158	5176	5194
100	4839	4857	4875	4893	4911	4929	4947	4965	4983	5001	5019	5037	5065	5073	5091	5109	5127	5145	5163	5181
101	4827	4845	4863	4881	4899	4916	4934	4952	4970	4988	5006	5024	5042	5060	5078	5096	5114	5132	5150	5168
102	4814	4832	4850	4868	4886	4904	4922	4939	4957	4975	4993	5011	5029	5047	5065	5083	5100	5118	5136	5154
103	4802	4819	4837	4855	4873	4891	4909	4927	4944	4962	4980	4998	5016	5034	5051	5069	5087	5105	5123	5141
104	4789	4807	4825	4842	4860	4878	4896	4914	4931	4949	4967	4985	5003	5020	5038	5056	5074	5092	5109	5127
105	4776	4794	4812	4830	4847	4865	4883	4901	4918	4936	4954	4972	4989	5007	5025	5043	5060	5078	5096	5114
106	4764	4782	4799	4817	4835	4852	4870	4888	4905	4923	4941	4959	4976	4994	5012	5029	5047	5065	5082	5100
107	4751	4769	4787	4804	4822	4840	4857	4875	4893	4910	4928	4945	4963	4981	4998	5016	5034	5051	5069	5087
108	4740	4757	4775	4792	4810	4828	4845	4863	4881	4898	4916	4933	4951	4969	4986	5004	5021	5039	5057	5074
109	4727	4745	4762	4780	4797	4815	4832	4850	4868	4885	4903	4920	4938	4955	4973	4991	5008	5026	5043	5061
110	4714	4732	4750	4767	4785	4802	4820	4837	4855	4872	4890	4907	4925	4942	4960	4977	4995	5012	5030	5047
111	4702	4719	4737	4754	4772	4789	4807	4824	4842	4859	4877	4894	4912	4929	4946	4964	4981	4999	5016	5034
112	4689	4707	4724	4742	4759	4776	4794	4811	4829	4846	4864	4881	4898	4916	4933	4951	4968	4985	5003	5020
113	4677	4694	4711	4729	4746	4764	4781	4798	4816	4833	4850	4868	4885	4903	4920	4937	4955	4972	4989	5007
114	4664	4681	4699	4716	4733	4751	4768	4785	4803	4820	4837	4855	4872	4889	4907	4924	4941	4959	4976	4993
115	4652	4669	4686	4703	4721	4738	4755	4773	4790	4807	4824	4842	4859	4876	4893	4911	4928	4945	4963	4980
116	4640	4657	4674	4692	4709	4726	4743	4760	4778	4795	4812	4829	4847	4864	4881	4898	4916	4933	4950	4967
117	4628	4645	4663	4680	4697	4714	4731	4749	4766	4783	4800	4817	4834	4852	4869	4886	4903	4920	4938	4955
118	4616	4634	4651	4668	4685	4702	4719	4737	4754	4771	4788	4805	4822	4839	4857	4874	4891	4908	4925	4942
119	4605	4622	4639	4656	4673	4690	4707	4724	4742	4759	4776	4793	4810	4827	4844	4861	4878	4896	4913	4930
120	4593	4610	4627	4644	4661	4679	4696	4713	4730	4747	4764	4781	4798	4815	4832	4849	4866	4883	4900	4917
121	4581	4598	4615	4632	4649	4667	4684	4701	4718	4735	4752	4769	4786	4803	4820	4837	4854	4871	4888	4905
122	4570	4587	4604	4621	4638	4655	4672	4689	4706	4723	4740	4757	4773	4790	4807	4824	4841	4858	4875	4892
123	4559	4576	4593	4610	4627	4644	4661	4677	4694	4711	4728	4745	4762	4779	4796	4813	4830	4847	4864	4881
124	4547	4564	4581	4598	4615	4632	4649	4666	4682	4699	4716	4733	4750	4767	4784	4801	4818	4834	4851	4868
125	4536	4552	4569	4586	4603	4620	4637	4654	4670	4687	4704	4721	4738	4755	4771	4788	4805	4822	4839	4856
126	4524	4541	4557	4574	4591	4608	4625	4641	4658	4675	4692	4709	4726	4742	4759	4776	4793	4810	4826	4843
127	4512	4529	4546	4562	4579	4596	4613	4630	4646	4663	4680	4697	4713	4730	4747	4764	4780	4797	4814	4831
128	4500	4517	4534	4551	4567	4584	4601	4618	4634	4651	4668	4684	4701	4718	4735	4751	4768	4785	4801	4818
129	4489	4506	4522	4539	4556	4572	4589	4606	4622	4639	4656	4672	4689	4706	4722	4739	4756	4772	4789	4806
130	4477	4494	4510	4527	4544	4560	4577	4594	4610	4627	4643	4660	4677	4693	4710	4727	4743	4760	4777	4793

COMP. INLET TEMP. °F	28.9	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.9	30.0	30.1	302
94	5280	5298	5317	5335	5353	5371	5390	5408	5426	5444	5463	5481	5499	58
95	5267	5285	5303	5321	5339	5358	5376	5394	5412	5431	5449	5467	5485	53
96	5253	5271	5289	5308	5326	5344	5362	5380	5398	5417	5435	5453	5471	59
97	5240	5258	5276	5294	5312	5330	5348	5366	5385	5403	5421	5439	5457	56
98	5226	5244	5262	5280	5298	5316	5334	5353	5371	5389	5407	5425	5443	54
99	5213	5231	5249	5267	5285	5303	5321	5339	5357	5375	5393	5411	5429	54
100	5199	5217	5235	5253	5271	5289	5307	5325	5343	5361	5379	5397	5415	54
101	5185	5203	5221	5239	5257	5275	5293	5311	5329	5347	5365	5383	5401	54
102	5172	5190	5208	5226	5243	5261	5279	5297	5315	5333	5351	5369	5387	54
103	5158	5176	5194	5212	5230	5248	5265	5283	5301	5319	5337	5355	5372	53
104	5145	5163	5180	5198	5216	5234	5252	5269	5287	5305	5323	5341	5358	53
105	5131	5149	5167	5185	5202	5220	5238	5256	5273	5291	5309	5327	5344	53
106	5118	5136	5153	5171	5189	5206	5224	5242	5259	5277	5295	5313	5330	53
107	5104	5122	5140	5157	5175	5193	5210	5228	5246	5263	5281	5299	5316	53
108	5092	5109	5127	5145	5162	5180	5197	5215	5233	5250	5268	5286	5303	53
109	5078	5096	5113	5131	5149	5166	5184	5201	5219	5236	5254	5272	5289	53
110	5065	5082	5100	5117	5135	5152	5170	5187	5205	5222	5240	5257	5275	52
111	5051	5069	5086	5104	5121	5139	5156	5174	5191	5208	5226	5243	5261	52
112	5038	5055	5073	5090	5107	5125	5142	5160	5177	5195	5212	5229	5247	52
113	5024	5042	5059	5076	5094	5111	5128	5146	5163	5181	5198	5215	5233	52
114	5011	5028	5045	5063	5080	5097	5115	5132	5149	5167	5184	5201	5219	52
115	4997	5014	5032	5049	5066	5084	5101	5118	5135	5153	5170	5187	5205	52
116	4985	5002	5019	5036	5054	5071	5088	5105	5122	5140	5157	5174	5191	52
117	4972	4989	5006	5024	5041	5058	5075	5092	5110	5127	5144	5161	5178	51
118	4959	4977	4994	5011	5028	5045	5062	5080	5097	5114	5131	5148	5165	51
119	4947	4964	4981	4998	5015	5032	5050	5067	5084	5101	5118	5135	5152	51
120	4935	4952	4969	4986	5003	5020	5037	5054	5071	5088	5105	5122	5139	51
121	4922	4939	4956	4973	4990	5007	5024	5041	5058	5075	5092	5109	5126	51
122	4909	4926	4943	4960	4977	4994	5011	5028	5045	5062	5079	5096	5113	51
123	4898	4915	4932	4948	4965	4982	4999	5016	5033	5050	5067	5084	5101	51
124	4885	4902	4919	4936	4953	4970	4987	5004	5020	5037	5054	5071	5088	51
125	4873	4889	4906	4923	4940	4957	4974	4991	5007	5024	5041	5058	5075	50
126	4860	4877	4894	4910	4927	4944	4961	4978	4994	5011	5028	5045	5062	50
127	4847	4864	4881	4898	4915	4931	4948	4965	4982	4998	5015	5032	5049	50
128	4835	4852	4868	4885	4902	4918	4935	4952	4969	4985	5002	5019	5036	50
129	4822	4839	4856	4872	4889	4906	4922	4939	4956	4972	4989	5006	5023	50
130	4810	4826	4843	4860	4876	4893	4910	4926	4943	4959	4976	4993	5009	50

COMP. INLET TEMP. °F	30.3	30.4	30.5	30.6	30.7	30.8	30.9	31.0	31.1	31.2	31.3	31.4	31.5	MAXIMUM ALLOWABLE S.F.C. #/HR/#F
94	5536	5554	5572	5591	5609	5627	5645	5664	5682	5700	5718	5737	5755	1.081
95	5522	5540	5558	5576	5594	5613	5631	5649	5667	5686	5704	5722	5740	1.082
96	5507	5526	5544	5562	5580	5598	5616	5635	5653	5671	5689	5707	5725	1.083
97	5493	5511	5530	5548	5566	5584	5602	5620	5638	5656	5674	5693	5711	1.084
98	5479	5497	5515	5533	5551	5569	5588	5606	5624	5642	5660	5678	5696	1.084
99	5465	5483	5501	5519	5537	5555	5573	5591	5609	5627	5645	5663	5681	1.085
100	5451	5469	5487	5505	5523	5541	5559	5577	5595	5612	5630	5648	5666	1.086
101	5436	5454	5472	5490	5508	5526	5544	5562	5580	5598	5616	5634	5652	1.087
102	5422	5440	5458	5476	5494	5512	5530	5548	5565	5583	5601	5619	5637	1.088
103	5408	5426	5444	5462	5480	5497	5515	5533	5551	5569	5587	5604	5622	1.088
104	5394	5412	5430	5447	5465	5483	5501	5519	5536	5554	5572	5590	5607	1.089
105	5380	5398	5415	5433	5451	5469	5486	5504	5522	5539	5557	5575	5593	1.090
106	5366	5383	5401	5419	5436	5454	5472	5490	5507	5525	5543	5560	5578	1.091
107	5351	5369	5387	5404	5422	5440	5457	5475	5493	5510	5528	5546	5563	1.091
108	5338	5356	5374	5391	5409	5426	5444	5462	5479	5497	5514	5532	5550	1.092
109	5324	5342	5359	5377	5394	5412	5430	5447	5465	5482	5500	5517	5535	1.093
110	5310	5328	5345	5363	5380	5398	5415	5433	5450	5468	5485	5503	5520	1.094
111	5296	5313	5331	5348	5366	5383	5401	5418	5436	5453	5470	5488	5505	1.095
112	5282	5299	5316	5334	5351	5369	5386	5404	5421	5438	5456	5473	5491	1.095
113	5267	5285	5302	5320	5337	5354	5372	5389	5406	5424	5441	5459	5476	1.096
114	5253	5271	5288	5305	5323	5340	5357	5375	5392	5409	5427	5444	5461	1.097
115	5239	5256	5274	5291	5308	5325	5343	5360	5377	5395	5412	5429	5446	1.098
116	5226	5243	5260	5278	5295	5312	5329	5347	5364	5381	5398	5416	5433	1.099
117	5213	5230	5247	5264	5282	5299	5316	5333	5350	5367	5385	5402	5419	1.100
118	5200	5217	5234	5251	5268	5285	5303	5320	5337	5354	5371	5388	5405	1.100
119	5186	5203	5221	5238	5255	5272	5289	5306	5323	5340	5357	5375	5392	1.101
120	5174	5191	5208	5225	5242	5259	5276	5293	5310	5327	5344	5361	5378	1.102
121	5160	5177	5194	5211	5228	5245	5262	5279	5296	5313	5330	5347	5364	1.103
122	5147	5164	5181	5198	5215	5232	5249	5266	5283	5300	5317	5334	5351	1.104
123	5135	5152	5169	5186	5203	5219	5236	5253	5270	5287	5304	5321	5338	1.105
124	5122	5139	5155	5172	5189	5206	5223	5240	5267	5274	5291	5308	5324	1.106
125	5108	5125	5142	5159	5176	5193	5210	5226	5243	5260	5277	5294	5311	1.106
126	5095	5112	5129	5146	5162	5179	5196	5213	5230	5247	5263	5280	5297	1.107
127	5082	5099	5116	5132	5149	5166	5183	5199	5216	5233	5250	5267	5283	1.108
128	5069	5086	5102	5119	5136	5153	5169	5186	5203	5219	5236	5253	5270	1.109
129	5056	5073	5089	5106	5123	5139	5156	5173	5189	5206	5223	5239	5256	1.110
130	5043	5059	5076	5093	5109	5126	5142	5159	5176	5192	5209	5226	5242	1.111

J47-23593

Figure 7-27. Performance Chart 25 and 27 7953

Pages 323 through 346 and Figures 7-28 through 7-36 have been deleted.

MODEL

J47-GE-25
J47-GE-27

7953 RPM

CHART CALCULATED FOR RAM DIFFERENTIAL PRESSURE O INCH H_2O

MAXIMUM ALLOWABLE EXHAUST GAS TEMPERATURE 690°C (1275°F)

VAPOR PRESSURE CORRECTION CHART

VAPOR PRESS. ("HG)	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	1.1	1.2
THRUST CORR. (SUBT)	2	4	6	8	10	12	14	16	18	20	22	24
SFC CORR. (ADD)	.002	.003	.004	.006	.007	.009	.010	.012	.014	.015	.016	.018
EGT CORR. (SUBT)	1	1	1	2	2	3	3	4	4	5	5	6

MINIMUM ALLOWABLE THRUST - POUNDS
COMPRESSOR INLET PRESSURE - INCHES HG ABSOLUTE

COMP. INLET TEMP. °F	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	26.0	26.1	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9	27.0	27.1	27.2	27.3
56	5027	5047	5067	5087	5107	5127	5147	5167	5187	5208	5228	5248	5268	5288	5308	5328	5348	5368	5388	5408	5429	5449	5469	5489
57	5015	5035	5055	5075	5095	5115	5135	5155	5175	5195	5215	5236	5256	5276	5296	5316	5336	5356	5376	5396	5416	5436	5456	5476
58	5003	5023	5043	5063	5083	5103	5123	5143	5163	5183	5203	5223	5243	5363	5383	5303	5323	5343	5363	5383	5403	5423	5443	5463
59	4992	5012	5032	5051	5071	5091	5111	5131	5151	5171	5191	5211	5231	5251	5271	5291	5311	5331	5351	5371	5391	5411	5431	5451
60	4980	5000	5020	5040	5060	5079	5099	5119	5139	5159	5179	5199	5219	5239	5259	5278	5298	5318	5338	5358	5378	5398	5418	5438
61	4968	4988	5008	5028	5048	5068	5087	5107	5127	5147	5167	5187	5207	5226	5246	5266	5286	5306	5326	5346	5365	5385	5405	5425
62	4957	4976	4996	5016	5036	5056	5075	5095	5115	5135	5155	5174	5194	5214	5234	5254	5274	5293	5313	5333	5353	5373	5392	5412
63	4945	4965	4984	5004	5024	5044	5063	5083	5103	5123	5142	5162	5182	5202	5222	5242	5261	5281	5301	5320	5340	5360	5380	5399
64	4933	4953	4973	4992	5012	5032	5051	5071	5091	5111	5130	5150	5170	5189	5209	5229	5249	5268	5288	5308	5327	5347	5367	5387
65	4921	4941	4961	4980	5000	5020	5039	5059	5079	5098	5118	5138	5157	5177	5197	5216	5236	5256	5276	5295	5315	5335	5354	5374
66	4909	4929	4948	4968	4987	5007	5027	5046	5066	5086	5105	5125	5144	5164	5184	5203	5223	5242	5262	5282	5301	5321	5341	5360
67	4897	4917	4936	4956	4976	4995	5015	5034	5054	5073	5093	5113	5132	5152	5171	5191	5210	5230	5250	5269	5289	5308	5328	5347
68	4885	4904	4924	4943	4963	4982	5002	5021	5041	5060	5080	5099	5119	5139	5158	5178	5197	5217	5236	5256	5275	5295	5314	5334
69	4872	4892	4911	4931	4950	4970	4989	5009	5028	5047	5067	5086	5106	5125	5145	5164	5184	5203	5223	5242	5262	5281	5301	5320
70	4860	4879	4898	4918	4937	4957	4976	4996	5015	5034	5054	5073	5093	5112	5132	5151	5170	5190	5209	5229	5248	5268	5287	5306
71	4847	4866	4886	4905	4925	4944	4963	4983	5002	5021	5041	5060	5080	5099	5118	5138	5157	5176	5196	5215	5235	5254	5273	5293
72	4835	4854	4873	4893	4912	4931	4951	4970	4989	5009	5028	5047	5067	5086	5105	5124	5144	5163	5182	5202	5221	5240	5260	5279
73	4822	4841	4861	4880	4899	4918	4938	4957	4976	4995	5015	5034	5053	5073	5092	5111	5130	5150	5169	5188	5208	5227	5246	5265
74	4809	4829	4848	4867	4886	4906	4925	4944	4963	4983	5002	5021	5040	5059	5079	5098	5117	5136	5156	5175	5194	5213	5232	5252
75	4797	4816	4835	4854	4874	4893	4912	4931	4950	4969	4989	5008	5027	5046	5065	5085	5104	5123	5142	5161	5180	5200	5219	5238
76	4784	4804	4823	4842	4861	4880	4899	4918	4937	4957	4976	4995	5014	5033	5052	507	5090	5110	5129	5148	5167	5186	5205	5224
77	4772	4791	4810	4829	4848	4867	4886	4905	4925	4944	4963	4982	5001	5020	5039	505	5077	5096	5115	5134	5153	5172	5192	5211
78	4759	4778	4797	4816	4835	4854	4873	4892	4912	4931	4950	4969	4988	5007	5026	504	5064	5083	5102	5121	5140	5159	5178	5197
79	4747	4766	4785	4804	4823	4842	4861	4880	4899	4918	4937	4956	4975	4993	5012	503	5050	5069	5088	5107	5126	5145	5164	5183
80	4735	4754	4773	4792	4811	4830	4849	4868	4887	4905	4924	4943	4962	4981	5000	501	5038	5057	5076	5095	5114	5133	5152	5170
81	4723	4741	4760	4779	4798	4817	4836	4855	4874	4893	4911	4930	4949	4968	4987	500	5025	5044	5062	5081	5100	5119	5138	5157
82	4710	4729	4748	4767	4785	4804	4823	4842	4861	4880	4898	4917	4936	4955	4974	499	5011	5030	5049	5068	5087	5105	5124	5143
83	4698	4716	4735	4754	4773	4791	4810	4829	4848	4866	4885	4904	4923	4942	4960	497	4998	5017	5035	5054	5073	5092	5111	5129
84	4685	4704	4722	4741	4760	4779	4797	4816	4835	4854	4872	4891	4910	4928	4947	496	4985	5003	5022	5041	5060	5078	5097	5116
85	4672	4691	4710	4728	4747	4766	4785	4803	4822	4841	4859	4878	4897	4915	4934	495	4971	4990	5009	5027	5046	5065	5083	5102
86	4661	4679	4698	4717	4735	4754	4773	4791	4810	4828	4847	4866	4884	4903	4922	494	4959	4978	4996	5015	5033	5052	5071	5089
87	4649	4668	4686	4705	4723	4742	4761	4779	4798	4816	4835	4854	4872	4891	4909	492	4946	4965	4984	5002	5021	5039	5058	5077
88	4637	4656	4674	4693	4712	4730	4749	4767	4786	4804	4823	4841	4860	4878	4897	491	4934	4953	4971	4990	5008	5027	5045	5064
89	4626	4644	4663	4681	4700	4718	4737	4755	4774	4792	4811	4829	4848	4866	4885	490	4922	4940	4959	4977	4996	5014	5032	5051
90	4614	4632	4651	4669	4688	4706	4725	4743	4762	4780	4798	4817	4835	4854	4872	489	4909	4928	4946	4964	4983	5001	5020	5038
91	4602	4621	4639	4657	4676	4694	4713	4731	4749	4768	4786	4805	4823	4841	4860	487	4897	4915	4933	4952	4970	4989	5007	5025
92	4591	4609	4627	4646	4664	4682	4701	4719	4737	4756	4774	4792	4811	4829	4848	486	4884	4903	4921	4939	4958	4976	4994	5013
93	4579	4597	4616	4634	4652	4670	4689	4707	4725	4744	4762	4780	4799	4817	4835	485	4872	4890	4908	4927	4945	4963	4982	5000

COMP. INLET TEMP. °F	27.4	27.5	27.6	27.7	27.8	27.9	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	29.0	29.1	29.2	29.3
56	5509	5529	5549	5569	5589	5609	5629	5650	5670	5690	5710	5730	5750	5770	5790	5810	5830	5851	5871	5891
57	5496	5516	5536	5556	5576	5596	5616	5636	5657	5677	5697	5717	5737	5757	5777	5797	5817	5837	5857	5877
58	5483	5503	5523	5543	5563	5583	5603	5623	5643	5663	5683	5703	5723	5743	5763	5783	5803	5823	5843	5863
59	5470	5490	5510	5530	5550	5570	5590	5610	5630	5650	5670	5690	5710	5730	5750	5770	5790	5810	5830	5850
60	5458	5478	5497	5517	5537	5557	5577	5597	5617	5637	5657	5677	5697	5716	5736	5756	5776	5796	5816	5836
61	5445	5455	5485	5504	5524	5544	5564	5584	5604	5624	5643	5663	5683	5703	5723	5743	5763	5782	5802	5822
62	5432	5452	5472	5491	5511	5531	5551	5571	5591	5610	5630	5650	5670	5690	5709	5729	5749	5769	5789	5808
63	5419	5439	5459	5478	5498	5518	5538	5558	5577	5597	5617	5637	5657	5676	5696	5716	5735	5755	5775	5795
64	5406	5426	5446	5466	5485	5505	5525	5544	5564	5584	5604	5623	5643	5663	5682	5702	5722	5742	5761	5781
65	5394	5413	5433	5453	5472	5492	5512	5531	5551	5571	5590	5610	5630	5649	5669	5689	5708	5728	5748	5767
66	5380	5399	5419	5439	5458	5478	5498	5517	5537	5556	5576	5596	5615	5635	5655	5674	5694	5713	5733	5753
67	5367	5387	5406	5426	5445	5465	5484	5504	5524	5543	5563	5582	5602	5622	5641	5661	5680	5700	5719	5739
68	5353	5373	5392	5412	5431	5451	5470	5490	5510	5529	5549	5568	5588	5607	5627	5646	5666	5685	5705	5724
69	5340	5359	5379	5398	5418	5437	5456	5476	5495	5515	5534	5554	5573	5593	5612	5632	5651	5671	5690	5710
70	5326	5345	5365	5384	5403	5423	5442	5462	5481	5501	5520	5539	5559	5578	5598	5617	5637	5656	5675	5695
71	5312	5331	5351	5370	5390	5409	5428	5448	5467	5486	5506	5525	5545	5564	5583	5603	5622	5641	5661	5680
72	5298	5318	5337	5356	5376	5395	5414	5434	5453	5472	5492	5511	5530	5550	5567	5588	5608	5627	5646	5666
73	5285	5304	5323	5342	5362	5381	5400	5420	5439	5458	5477	5497	5516	5535	5554	5574	5593	5612	5632	5651
74	5271	5290	5309	5329	5348	5367	5386	5405	5425	5444	5463	5482	5502	5521	5540	5559	5578	5598	5617	5636
75	5257	5276	5295	5315	5334	5353	5372	5391	5411	5430	5449	5468	5487	5506	5526	5545	5564	5583	5602	5621
76	5243	5263	5282	5301	5320	5339	5358	5377	5396	5416	5435	5454	5473	5492	5511	5530	5549	5569	5588	5607
77	5230	5249	5268	5287	5306	5325	5344	5363	5382	5401	5420	5440	5459	5478	5497	5516	5535	5554	5573	5592
78	5216	5235	5254	5273	5292	5311	5330	5349	5368	5387	5406	5425	5444	5463	5482	5501	5520	5539	5558	5577
79	5202	5221	5240	5259	5278	5297	5316	5335	5354	5373	5392	5411	5430	5449	5468	5487	5506	5525	5544	5563
80	5189	5208	5227	5246	5265	5284	5303	5322	5341	5360	5379	5398	5417	5435	5454	5473	5492	5511	5530	5549
81	5176	5195	5213	5232	5251	5270	5289	5308	5327	5346	5364	5383	5402	5421	5440	5459	5478	5497	5515	5534
82	5162	5181	5200	5218	5237	5256	5275	5294	5313	5331	5350	5369	5388	5407	5426	5444	5463	5482	5501	5520
83	5148	5167	5186	5204	5223	5242	5261	5280	5298	5317	5336	5355	5373	5392	5411	5430	5449	5467	5486	5505
84	5134	5153	5172	5191	5209	5228	5247	5266	5284	5303	5322	5340	5359	5378	5397	5415	5434	5453	5472	5490
85	5121	5139	5158	5177	5195	5214	5233	5251	5270	5289	5307	5326	5345	5363	5382	5401	5420	5438	5457	5476
86	5108	5127	5145	5164	5182	5201	5220	5238	5257	5276	5294	5313	5332	5350	5369	5387	5406	5425	5443	5462
87	5095	5114	5132	5151	5169	5188	5207	5225	5244	5262	5281	5300	5318	5337	5355	5374	5392	5411	5430	5448
88	5082	5101	5119	5138	5156	5175	5194	5212	5231	5249	5268	5286	5305	5323	5342	5360	5379	5397	5416	5434
89	5069	5088	5106	5125	5143	5162	5180	5199	5217	5236	5254	5273	5291	5310	5328	5347	5365	5384	5402	5421
90	5057	5075	5094	5112	5130	5149	5167	5186	5204	5223	5241	5260	5278	5296	5315	5333	5352	5370	5389	5407
91	5044	5062	5081	5099	5117	5136	5154	5173	5191	5209	5228	5246	5265	5283	5301	5320	5338	5357	5375	5393
92	5031	5049	5068	5086	5104	5123	5141	5159	5178	5196	5215	5233	5251	5270	5288	5306	5325	5343	5361	5380
93	5018	5036	5055	5073	5091	5110	5128	5146	5165	5183	5201	5220	5238	5256	5274	5293	5311	5329	5348	5366

COMP. INLET TEMP. °F	29.4	29.5	29.6	29.7	29.8	29.9	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.7	30.8	30.9	31.0	31.1	31.2	31.3	31.4	31.5	MAXIMUM ALLOWABLE S.F.C. #/HR/#F	COMP. INLET TEMP. °F
56	5911	5931	5951	5971	5991	6011	6031	6051	6072	6092	6112	6132	6152	6172	6192	6212	6232	6252	6272	6293	6313	6333	1.059	56
57	5897	5917	5937	5957	5977	5997	6017	6037	6057	6077	6098	6118	6138	6158	6178	6198	6218	6238	6258	6278	6298	6318	1.059	57
58	5883	5903	5923	5943	5963	5983	6003	6023	6043	6063	6083	6103	6123	6143	6163	6183	6203	6223	6243	6263	6283	6303	1.060	58
59	5870	5889	5909	5929	5949	5969	5989	6009	6029	6049	6069	6089	6109	6129	6149	6169	6189	6209	6229	6249	6269	6289	1.060	59
60	5856	5876	5896	5915	5935	5955	5975	5995	6015	6035	6055	6075	6095	6115	6134	6154	6174	6194	6214	6234	6254	6274	1.060	60
61	5842	5862	5882	5902	5921	5941	5961	5981	6001	6021	6041	6061	6080	6100	6120	6140	6160	6180	6200	6219	6239	6259	1.061	61
62	5828	5848	5868	5888	5908	5927	5947	5967	5987	6007	6026	6046	6066	6086	6106	6125	6145	6165	6185	6205	6225	6244	1.061	62
63	5815	5834	5854	5874	5894	5913	5933	5953	5973	5992	6012	6032	6052	6071	6091	6111	6131	6151	6170	6190	6210	6230	1.062	63
64	5801	5820	5840	5860	5880	5899	5919	5939	5958	5978	5998	6018	6037	6057	6077	6097	6116	6136	6156	6175	6195	6215	1.062	64
65	5787	5807	5826	5846	5866	5885	5905	5925	5944	5964	5984	6003	6023	6043	6062	6082	6102	6121	6141	6161	6180	6200	1.063	65
66	5772	5792	5812	5831	5851	5870	5890	5910	5929	5949	5969	5988	6008	6027	6047	6067	6086	6106	6126	6145	6165	6184	1.063	66
67	5759	5778	5798	5817	5837	5856	5876	5896	5915	5935	5954	5974	5993	6013	6033	6052	6072	6091	6111	6130	6150	6170	1.064	67
68	5744	5763	5783	5802	5822	5841	5861	5881	5900	5920	5939	5959	5978	5998	6017	6037	6056	6076	6095	6115	6134	6154	1.065	68
69	5729	5749	5768	5788	5807	5827	5846	5865	5885	5904	5924	5943	5963	5982	6002	6021	6041	6060	6080	6099	6119	6138	1.065	69
70	5714	5734	5753	5773	5792	5811	5831	5850	5870	5889	5909	5928	5947	5967	5986	6006	6025	6045	6064	6083	6103	6122	1.066	70
71	5700	5719	5738	5758	5777	5796	5816	5833	5855	5874	5893	5913	5932	5951	5971	5990	6010	6029	6048	6068	6087	6106	1.067	71
72	5685	5704	5724	5743	5762	5782	5801	5820	5840	5859	5878	5897	5917	5936	5955	5975	5994	6013	6033	6052	6071	6091	1.067	72
73	5670	5689	5709	5728	5747	5766	5786	5805	5824	5844	5863	5882	5901	5921	5940	5959	5979	5998	6017	6036	6056	6075	1.068	73
74	5655	5675	5694	5713	5732	5752	5771	5790	5809	5828	5848	5867	5886	5905	5925	5944	5963	5982	6001	6021	6040	6059	1.068	74
75	5641	5660	5679	5698	5717	5736	5756	5775	5794	5813	5832	5852	5871	5890	5909	5928	5947	5967	5986	6005	6024	6043	1.069	75
76	5626	5645	5664	5683	5702	5722	5741	5760	5779	5798	5817	5836	5855	5875	5894	5913	5932	5957	5970	5989	6008	6028	1.069	76
77	5611	5630	5649	5668	5688	5707	5726	5745	5764	5783	5802	5821	5840	5859	5878	5897	5916	5935	5955	5974	5993	6012	1.070	77
78	5596	5615	5634	5653	5673	5692	5711	5730	5749	5768	5787	5806	5825	5844	5863	5882	5901	5920	5939	5958	5977	5996	1.070	78
79	5582	5601	5620	5639	5658	5677	5696	5715	5734	5752	5771	5790	5809	5828	5847	5866	5885	5904	5923	5942	5961	5980	1.071	79
80	5568	5587	5606	5625	5644	5663	5682	5700	5719	5738	5757	5776	5795	5814	5833	5852	5871	5890	5909	5928	5946	5965	1.072	80
81	5553	5572	5591	5610	5629	5648	5667	5685	5704	5723	5742	5761	5780	5799	5818	5836	5855	5874	5893	5912	5931	5950	1.072	81
82	5539	5557	5576	5595	5614	5633	5652	5670	5689	5708	5727	5746	5764	5783	5802	5821	5840	5859	5877	5896	5915	5934	1.073	82
83	5524	5542	5561	5580	5599	5618	5636	5655	5674	5693	5711	5730	5749	5768	5787	5805	5824	5843	5862	5880	5899	5918	1.074	83
84	5509	5528	5546	5565	5584	5603	5621	5640	5659	5678	5696	5715	5734	5752	5771	5790	5809	5827	5846	5865	5884	5802	1.074	84
85	5494	5513	5532	5550	5569	5588	5606	5625	5644	5662	5681	5700	5718	5737	5756	5774	5793	5812	5830	5849	5868	5886	1.075	85
86	5481	5499	5518	5536	5555	5574	5592	5611	5630	5648	5667	5686	5704	5723	5741	5760	5779	5797	5816	5835	5853	5872	1.076	86
87	5467	5485	5504	5523	5541	5560	5578	5597	5615	5634	5653	5671	5690	5708	5727	5746	5764	5783	5801	5820	5838	5857	1.076	87
88	5453	5472	5490	5509	5527	5546	5564	5583	5601	5620	5638	5657	5675	5694	5713	5731	5750	5768	5787	5805	5824	5842	1.077	88
89	5439	5458	5476	5495	5513	5532	5550	5569	5587	5606	5624	5643	5661	5680	5698	5717	5735	5754	5772	5791	5809	5828	1.078	89
90	5425	5444	5462	5481	5499	5518	5536	5555	5573	5591	5610	5628	5647	5665	5684	5702	5721	5739	5757	5776	5794	5813	1.078	90
91	5412	5430	5449	5467	5485	5504	5522	5541	5559	5577	5596	5614	5633	5651	5669	5688	5706	5725	5743	5761	5780	5798	1.079	91
92	5398	5416	5435	5453	5471	5490	5508	5526	5545	5563	5582	5600	5618	5637	5655	5673	5692	5710	5728	5747	5765	5783	1.080	92
93	5384	5403	5421	5439	5457	5476	5494	5512	5531	5549	5567	5586	5604	5622	5640	5659	5677	5695	5714	5732	5750	5769	1.081	93

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Figure 7–26. Performance Chart 25 and 27 7953